6.0 DELTA HABITAT AREA

6.1 EXISTING CONDITIONS

6.1.1 Physical Features

The Delta Habitat Area is located at the terminus of the Lower Owens River (Figure 6-1). It contains various riparian and wetland vegetation types that contrast sharply with adjacent unvegetated playa of the mostly dry Owens Lake and its margins. The MOU identified general boundaries of the Delta Habitat Area, and the area along the river where the pump station should be located, as shown on Figure 2-4. The Delta Habitat Area identified in the MOU was expanded to include the area between the Dust Control Road and Pipeline Corridors, between Zones 1 and 2 of the Owens Lake Dust Mitigation Program, and north of the brine pool (Figures 2-5 and 6-1). The north boundary of the Delta Habitat Area corresponds with the downstream edge of the road crossing the Owens River and linking Corridors 1 and 2. The elevated corridors and dikes along the perimeters of the Dust Mitigation Program zones confine the north, east and west boundaries of the Delta Habitat Area. The southern boundary corresponds with a subtle transition from vegetated wetland confined by shallow dunes and playa to the broadly depressed, unconfined brine pool transition area. The Delta Habitat Area contains 3,578 acres.

The Delta Habitat Area extends about 16,000 feet south from the Powerline Road at an approximate elevation of 3,585 feet to the maximum limit of the current brine pool at elevation 3,560 feet (Figure 6-1). The pump station location is about 4 river miles downstream of Keeler Bridge. The pump station site is also 3,000 linear feet upstream of Powerline Road.

Four land types were identified by White Horse Associates (2004) in the Delta Habitat Area based on 2000 conditions. They are described below by White Horse Associates and shown on Figure 6-2:

- ***Floodplain:*** Lands influenced by contemporary stream (floodplain) processes. Includes the floodplain of the Owens River, channels that are often discontinuous, ponds, and adjacent areas of dense vegetation sustained by shallow groundwater. Indices of hydric soil include aquic moisture regime, sulfidic odor, reducing conditions, gleyed or low-chroma colors, high organic content and organic streaking. Wetland hydrology indicators include inundation and saturation in the upper 12 inches. Hydric soil and wetland hydrology are present. Vegetative cover is high. Floodplains, most of which are potential jurisdictional wetlands per the Clean Water Act and U.S. Army Corps of Engineers guidelines, comprise 605 acres (17 percent) of the Delta Habitat Area. Small pockets of floodplain landtype are divorced from the west branch by dunes (Figure 6-2). Expansion of vegetated wetlands in the Delta Habitat Area generally corresponds with a conversion of lacustrine to floodplain landtype.

- ***Low terrace:*** Historic floodplains of the Owens River that have been left high-and-dry by channel incision. While low terrace is a major landtype in other parts of the LORP area, it is only a very minor component of the Delta Habitat Area. Indices of hydric soil and wetland hydrology are typically not evident. Rabbitbrush-Nevada saltbush/saltgrass-alkali sacaton is the dominant vegetation. Low terraces, all of which are upland, comprise only 14 acres (<1 percent) of the Delta Habitat Area.

- ***Aeolian*:** Lands influenced by wind (aeolian) processes. In the Delta Habitat Area, a veneer of loose, wind-blown sand and fine-gravel ranging from a foot to several meters deep is underlain by lake-bed (lacustrine) sediments. Indices of hydric soil and wetland hydrology are not evident in surface soils. Hydrophytic vegetation may be present, but with low canopy cover. Aeolian lands are typically not jurisdictional wetlands. They comprise 1,273 acres (36 percent) of the Delta Habitat Area. Aeolian land has expanded in a south-southeasterly direction since 1944 (see historical perspective, Section 6.1.3.4). Dunes have covered the west side of the historic floodplain and pushed the Delta Habitat Area outlet about 1 mile southeast since 1944. Wet spots (Figure 6-2) divorced from the main channel by dunes are sustained by infiltration through the coarse aeolian sediment. Boundaries between aeolian and lacustrine lands are diffuse. Inclusions of lacustrine land in aeolian land are common.

- ***Lacustrine:*** Lands influenced by lake (lacustrine) processes. Fine-texture, saline-alkaline sediments with very low permeability form the historic bed of Owens Lake. White salt crusts are common on the surface. Indices of hydric soil include sulfidic odor, aquic moisture regime, reducing conditions, and gleyed or low-chroma colors. In early May 2000, the water table in the Delta Habitat Area was typically 1 to 2 feet below the surface. Sediment was saturated in the upper 12 inches. Hydric soil and wetland hydrology were assumed present. Vegetation cover is sparse or absent. Lacustrine lands, small portions of which are potentially jurisdictional wetlands, comprise 1,686 acres (47 percent) of the Delta Habitat Area. The intermittently flooded brine pool transition area at the southern end of the Delta Habitat Area is included in lacustrine lands. The expansion of vegetated wetland in the Delta Habitat Area corresponds mostly with a conversion of lacustrine to floodplain landtype. The boundaries between lacustrine and aeolian lands are diffuse. Inclusions of aeolian land in lacustrine land are common.

The complex distribution of land types in the Delta Habitat Area is illustrated in Figure 6-2 and listed in Table 6-1.

TABLE 6-1
AREAS OF LAND TYPES, DELTA HABITAT AREA

Land Type	Acres	Percent
Fluvial	605	17
Low terrace	14	<1
Aeolian	1,273	36
Lacustrine	1,686	47
TOTAL =	3,578	100

Source: White Horse Associates (2004).

Several hundred feet downstream of Powerline Road, the river channel splits into the east and west branches (Figure 6-1) at a point called the “Y.” Historically, the west branch has contained the primary flows. It remains the primary conveyance channel and flows year-round. A sand dune confines the west boundary of the west branch. The channel of the west branch of the wetted floodplain varies from 300 feet wide near the “Y” to about 40-50 feet wide at the southern end of the Delta. Water depth in discontinuous channels and pools varies from about 6 feet at the northern end to less than an inch at the southern end of the Delta Habitat Area.

The east branch (Figure 6-1) receives flows created by a backwater effect from the west branch, where dense cattail and bulrush marsh vegetation has accumulated. It also receives water during higher flows to the Delta. A well-defined 50-foot wide channel is present at its origin. As the channel progresses downstream, it widens into a swale up to several hundred feet wide and often less than 1 foot deep. The channel eventually loses its integrity and flows spread out into a myriad of swales and depressions that coalesce at the southern end of the Delta and join the west channel.

At the southern end where the two branches converge, a broad sheet flow (referred to as the brine pool transition area) occurs below the convergence of the east and west branches and collects to the east of the brine pool before emptying into the brine pool. The overall channel gradient through the Delta has been estimated to be about 0.03 percent by Ecosystem Sciences (Technical Memorandum 8, January 1999).

A small overflow channel occurs along the western bank of the river about 800 feet upstream of the “Y” (Figure 6-1). This channel consists of an ephemeral drainage swale with poorly defined bed and banks. It receives seepage and surface flows when the water elevation in the main river channel overtops a low-lying portion of the bank. Under current flows in the river, it does not appear that surface water passes over the bank to this drainage. Instead, the drainage swale typically exhibits saturated soils and shallow water derived from seepage and high groundwater. A discussion of the amount and frequency of flows that would be diverted to the overflow channel under the LORP is provided in Section 6.3.3 (Potential for Bypass Flows to be Conveyed Away from the Center of the Delta).

6.1.2 Uses of the Delta

Most of the Delta Habitat Area occurs on State-owned lands, managed by the State Lands Commission (Figure 2-6). LADWP land occurs north of Powerline Road and east of the river, except for a small sliver of land that extends to the west of the west channel for about 8,000 feet. The small portion of the Delta Habitat Area that occurs on LADWP land is included in LADWP’s 7,100-acre Delta Lease, which extends north of the Delta area. LADWP land included in the Delta Habitat Area consists of a narrow band about 1,500 feet wide that runs parallel to the upper 4,000 feet of the west branch of the river (Figure 2-6). The total area of LADWP land in the Delta Habitat Area is 361 acres[1]. The proposed land management plan for the Delta Lease is described in Section 2.8.2.5. The LADWP lease lands (Delta Lease) are unfenced in the Delta. No grazing is authorized in the Delta Habitat Area proper, except for this narrow band of the LADWP lease. However, grazing appears to occur in the Delta Habitat Area between the east and west branches, and east of the east branch due to the absence of fences.

State lands are not managed by LADWP or the County, and thus, there are no proposed LORP-related land disturbances on State lands, except for the installation of two temporary gaging stations. Additionally, monitoring is proposed within Delta lands under SLC jurisdiction. LADWP will obtain a land use approval from SLC prior to installation of the gaging stations.

The Lone Pine elk herd occurs east of the Aqueduct from Manzanar Reward Road to the Delta Habitat Area. The herd primarily uses the alluvial fans of the Inyo Mountains. The herd spends the summer and fall along the Owens River in irrigated pastures on the Lone Pine Lease and at the Delta Habitat Area. The latter is considered a highly suitable calving area by the Bureau of Land Management.

The public is allowed access to the Delta Habitat Area on both LADWP and State lands for recreation, including hunting, bird watching, and fishing at the upper end.

In December 2001, LADWP began shallow flooding 11.9 square miles (7,639 acres) in an area along the northeast part of Owens Dry Lake referred to as Zone 2 (northeastern portion of the lake, immediately adjacent to the Delta Habitat Area; see Figure 6-1). By 2003, the Dust Mitigation Program included 15.4 square miles (9,823 acres) of shallow flooding. Shallow flooding areas are operated between October 1 and June 30 each year. In addition, as part of the CDFG Streambed Alteration Agreement for dust control activities in the southern portion of the lake, LADWP has committed to maintaining 1,000 acres of

[1] Since the publication of the Draft EIR/EIS, the acreage of LADWP land in the Delta Habitat Area was recalculated based on more recent GIS data compiled by CH2MHILL, consultant to LADWP for the Owens Lake Dust Mitigation Program.

shorebird habitat within Zone 2 shallow flood area and up to 1,000 acres of additional shorebird habitat using naturally occurring water. Additionally, 42 acres of wetlands will be created in an area west of the Delta Habitat Area.

6.1.3 Vegetation Types

The descriptions of vegetation and hydrologic conditions in the Delta Habitat Area presented in Section 6.1.3 are based primarily on analyses of aerial photographs that are available for 8 periods between 1944 and 2000. The most recent aerial photographs of the Delta Habitat Area are from 2000, which were taken as part of an Owens Valley-wide inventory of riparian and wetland resources. In Section 6.1.3 of the Draft EIR/EIS, the existing conditions description of the Delta was based primarily on the analysis of 1999 aerial photographs since the evaluation of the 2000 photographs had not been finalized at the time of Draft EIR/EIS publication in November 2002. Since the aerial photographs from 2000 are of higher quality than those taken earlier (including 1999) and are the most recent, Section 6.1.3.2 of the Final EIR/EIS has been revised to reflect the results of White Horse Associates mapping from the 2000 aerial photographs. The 2000 conditions are used in this document as the basis for the assessment of changes in the Delta Habitat Area. The results of mapping of aerial photographs from 1999 and the preceding years are presented in Table 6-3 and also discussed in Section 6.1.3.3 (Historical Perspective of Wetland Development).

The distribution of vegetation types and their wetland status have been addressed in studies conducted by Jones & Stokes (1996) and White Horse Associates (2004), each with different results. A historical perspective of changes in the extent of wetlands in the Delta Habitat Area can be surmised from interpretation of aerial photos and from mapping of 1993, 1996, 1999 and 2000 conditions by White Horse Associates.

6.1.3.1 Jones & Stokes Wetland Delineation of 1996 Conditions

A delineation of jurisdictional wetlands on the east side of the Owens Lake playa (from the Delta to Olancha) was conducted by Jones & Stokes (1996) and summarized by the Great Basin Unified Air Pollution Control District (GBUAPCD, 1997). Wetlands identified within the Delta Habitat Area as part of this study are shown in Figure 6-3. The perimeter of jurisdictional wetlands was determined by walking or driving the line between upland and wetland vegetation with a Global Positioning System (Jones & Stokes, 1996). The outermost line of wetland vegetation was determined by locating where obligate, facultative wetland and facultative plant species comprised at least 50 percent of the total aerial cover of herbaceous, shrub and tree strata.

Jones & Stokes (1996) identified 1,289 acres of jurisdictional wetland in the Delta Habitat Area. However, the western wetland boundary identified in the Jones & Stokes study (Figure 6-3) is 300 to 600 feet west of the vegetated wetland (based on White Horse Associates interpretation of aerial photographs with field verification; see below) and includes dunes and alkali scrub vegetation types typical of aeolian lands. Although sparse wetland vegetation is present in these areas, hydric soil and wetland hydrology are not evident. However, all three factors (vegetation, soils and hydrology) are required to designate Corps jurisdictional wetland. White Horse Associates believe that the delineation method used in the Jones & Stokes study resulted in an overestimate of the extent of jurisdictional wetlands in the Delta Habitat Area since it was based on the presence of wetland vegetation but not on hydric soil and wetland hydrology. The Corps requires investigation of all three conditions to determine jurisdictional wetlands, as described in the 1987 wetlands delineation manual (USACE, 1987).

6.1.3.2 White Horse Associates Mapping of 2000 Conditions

White Horse Associates (2004) mapped land types (Figure 6-2) and vegetation types (Figure 6-11) in the Delta Habitat Area from aerial photos dated September, 2000. Mapping was conducted from high-resolution (2-foot pixels) digital orthophotos plotted at 1:6,000 (1 inch = 500 feet) scale in color. This level of resolution is sufficient to pick up small shallow flooded areas and ponds important as waterfowl, wading bird, and shorebird habitat. While the Delta Habitat Area has not been officially delineated by the Corps, field descriptions of vegetation, soil and hydrologic parameters were used to assign a wetland status to combinations of landform and vegetation type following guidelines of the Corps' wetlands delineation manual (USACE, 1987). The area and status of vegetation types in the Delta Habitat Area from the 2000 aerial photos are listed in Table 6-2. The total area of potentially jurisdictional wetlands and "waters of the United States" was estimated to be 831 acres (23 percent of the Delta Habitat Area). The total estimated area of upland was 2,689 acres (75 percent of the Delta Habitat Area). The jurisdictional status of the intermittently flooded, nearly barren brine pool transition area (58 acres) in the Delta Habitat Area was not considered in the study conducted by White Horse Associates since determination of the jurisdictional status of unvegetated communities varies by local Corps office and site-specific conditions.

Given the complex and gradual-to-diffuse boundaries between wetland vegetation types (i.e., water, alkali marsh, wet alkali meadow, alkali meadow) and between upland vegetation types (i.e., alkali meadow, playa, Parry saltbush, and dune), the areas of individual vegetation types within wetland or upland categories should be viewed with discretion. In contrast, boundaries between upland and wetlands are generally more abrupt. Descriptions of vegetation and miscellaneous types that follow are generally ordered from wet to dry.

TABLE 6-2
VEGETATION TYPES MAPPED IN THE DELTA HABITAT AREA – 2000

Vegetation Type	Potential Jurisdictional Status	Area	
		acres	percent
Water	Waters of US	**7**	**<1**
Vegetated Wetland			
Alkali marsh (marsh)*	Wetland	192	5
Wet alkali meadow	Wetland	366	10
Alkali meadow (dry alkali meadow)*	Wetland	248	7
Goodding-red willow (riparian forest)*	Wetland	18	1
Subtotal (Vegetated Wetland)		**824**	**23**
Total (Vegetated Wetland + Water)		**831**	**23**
Upland			
Alkali meadow (dry alkali meadow)*	Upland	19	1
Rabbitbrush-Nevada saltbush (alkali scrub)*	Upland	8	<1
Parry saltbush (alkali scrub)*	Upland	1,210	34
Dune	Upland	50	1
Playa	Upland	1,402	39
Subtotal (Upland)		**2,689**	**75**
Intermittently Flooded Playa within the Brine Pool Transition Area	Not Considered	**58**	**2**
TOTAL (Delta Habitat Area)		**3,578**	**100**

Source: White Horse Associates (2004)
* In the report prepared by White Horse Associates (2004), the names of vegetation types were changed from those presented in the Draft EIR/EIS to more specifically identify the vegetation types that exists in the Delta and distinguish them from similar vegetation types that are present in other areas of the Owens Valley. The names used in the Draft EIR/EIS are shown in parentheses.

A description of the different vegetation types is provided below (White Horse Associates, 2004):

- **Alkali marsh (bulrush-cattail association):** This vegetation type includes permanently flooded and saturated habitat dominated by obligate hydrophytes. Dominant plants include southern cattail (*Typha latifolia)*, hard-stem bulrush, saltmarsh bulrush (*Typha maritimus*) and creeping spikerush (*Eleocharis macrostachya*). Total vegetative cover exceeds 90 percent. Obligate wetland species are prominent. This vegetation type occurs on floodplain landtypes. Wetland hydrology and hydric soils are evident. These habitats are vegetated wetlands. Inclusions of water and broad transitions to wet alkali meadow are common. Areas transitional in character from wet alkali meadow to marsh are also common, especially in the west branch. This vegetation type corresponds to transmontane alkali marsh in the Holland (1986) vegetation classification system and in the Green Book (LADWP and Inyo County, 1990).

- **Goodding-red willow (Goodding-red willow/bulrush-cattail association).** This relict vegetation type is permanently flooded habitat. Goodding willow (*Salix gooddingii*) is the dominant tree in the Delta Habitat Area; Fremont cottonwood (*Populus fremontii*) may be present; total tree cover ranges from 10 to 60 percent. The understory is similar to that described for alkali marsh. Obligate wetland species are prominent. Hydrophilic vegetation is present; wetland hydrology and hydric soil are also evident. These areas are vegetated wetland. Boundaries with marsh vegetation type are somewhat arbitrary, encompassing areas with significant tree canopy. Trees are decadent, dying or dead. Trees were established on scoured, seasonally flooded substrate that has since been inundated and engulfed by marsh vegetation. Given the existing hydrologic character of the Delta Habitat Area, riparian trees are expected to die and are not likely to regenerate naturally. Because of sparse foliage on the decadent trees, these areas are difficult to distinguish from the surrounding marsh on the orthophotos, resulting in a relatively high expected error. This vegetation type corresponds most closely to Mojave riparian forest in the Holland (1986) vegetation classification system and in the Green Book (LADWP and Inyo County, 1990). The Goodding-red willow series also includes associations with dryer understories (i.e. Goodding-red willow/creeping wildrye-saltgrass and Goodding-red willow/scrub).

- **Wet alkali meadow (saltgrass-rush association).** This vegetation type occurs mostly on floodplains with high water table in the Delta Habitat Area (366 acres). A single, somewhat atypical, parcel (22 acres) occurs on floodplain that is intermittently flooded in the brine pool transition area. . Dominant plants include saltgrass, Mexican rush (*Juncus mexicanus*), clustered field sedge (*Carex praegracilis*), and three-square bulrush (*Scirpus pungens*). Scattered saltcedar (*Tamarix ramosissima*) may be present. Total vegetative cover is greater than 50 percent. Facultative wetland species are prominent. Wetland hydrology and hydric soil are evident. These areas are vegetated wetland. Boundaries with alkali meadow (saltgrass) and marsh (bulrush-cattail) are gradual to diffuse. Areas transitional from alkali meadow to wet alkali meadow and areas transitional from wet alkali meadow to marsh are common. This vegetation type corresponds to transmontane alkali meadow in the Holland (1986) vegetation classification system and in the Green Book (LADWP and Inyo County, 1990).

- **Alkali meadow (saltgrass association).** This vegetation type occurs on floodplain, low terrace, lacustrine and aeolian lands with contrasting soil and hydrologic characteristics. The dominant species is saltgrass; scattered Parry's saltbush (*Atriplex parryi*) and Torrey seepweed (*Suada moquinii*) may be present. Total cover ranges from 20 to 70 percent. Facultative wetland species are prominent. Wetland hydrology and hydric soils are evident in floodplains and lacustrine lands that total 248 acres, but not on low terrace and aeolian lands (19 acres). Alkali meadow occurring on floodplains and lacustrine land is vegetated wetland. Alkali meadow occurring on low terrace and aeolian land is not wetland. This vegetation type corresponds to transmontane alkali meadow in the Holland (1986) vegetation classification system and in the Green Book (LADWP and Inyo County, 1990).

- **Parry saltbush (Parry saltbush-Torrey seepweed association).** This vegetation type includes sandy habitat dominated by alkali tolerant shrub and herbaceous species. The shrub stratum typically includes Parry saltbush (*Atriplex parryi*) and Torrey seepweed (*Suada moquinii*); Nevada saltbush (*Atriplex lentiformis ssp. torreyi*), shrubby alkali aster (*Macoranthera carnosa*) and greasewood (*Sarcobatus vermiculatus*) are also common. Saltgrass is typically present, but with low cover. Total shrub cover ranges from 10 to 30 percent; total herbaceous cover is less than 10 percent. Facultative wetland species are prominent. Soils consist of surface deposits of wind-blown sand over lacustrine sediments. The depth of the sand varies from 1 to several feet. Indices of hydric soil and wetland hydrology are not evident in surface horizons, as required for wetland status. These areas are not wetland. Boundaries with unvegetated playa in lacustrine lands are typically complex and diffuse – areas identified as Parry saltbush scrub may contain up to 25 percent inclusions of playa. Boundaries with wetland vegetation types are generally clear. This vegetation corresponds to desert sink scrub in the Holland (1986) vegetation classification system and in the Green Book (LADWP and Inyo County, 1990). This vegetation type occurs only in aeolian lands in the Delta Habitat Area (Figure 6-2), mostly west of the west branch and between the east and west branches.

- **Rabbitbrush-Nevada saltbush (rabbitbrush-NV saltbush/saltgrass-alkali sacaton association).** This low shrub vegetation type occurs on low terraces with low water table. The dominant low shrubs were Nevada saltbush (*Atriplex lentiformis ssp. Torreyi*) and rubber rabbitbrush (*Chrysothamnus nauseosus*); greasewood (*Sarcobatus vermiculatus)* was present in some parcels. Total average shrub cover was variable, but averaged 40 percent. Saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobous airoides*), and Torrey seepweed (*Sueda moquinii*) were prominent herbaceous plants; average total herbaceous cover was 50 percent. These areas are typically not vegetated wetland. This type corresponds with the Nevada saltbush meadow and rabbitbrush meadow in the Holland (1994) vegetation types. It also resembles the alkali meadow Holland vegetation type, which may include significant alkali shrub canopy. This vegetation type comprises only 8 acres of the Delta Habitat Area, but is extensive along the Lower Owens River.

- **Dune.** Similar to the Parry saltbush series, dunes occur in aeolian lands, but the depth of sand varies from 1 to 2 meters. Clusters of alkali tolerant shrubs (shrubby alkali aster, greasewood, Torrey seepweed, and tamarisk) are typically present. Sparse saltgrass is usually present in the herbaceous layer, often distributed in lines, each corresponding with a single rhizome. Total shrub cover ranges from 0 to 20 percent; total herbaceous cover is less than 20 percent. Hydric soil and wetland hydrology are not evident. These areas are not wetland. Dunes occur along the western flank of the west branch. Boundaries with Parry saltbush series are diffuse.

In addition to the above vegetation types, several non-vegetated habitats are present:

- **Water.** Permanently flooded aquatic habitat typically complimented by sparse obligate hydrophytes with less than 25 percent total cover. Water is typically less than 3 feet deep and occurs in discontinuous channels and shallow depressions in floodplain landtype.. Southern cattail (*Typha domingensis*), hard-stem bulrush (*Scirpus acutus*), duck-weed (*Lemna* sp.) and algae are typically present. Wetland hydrology is evident. These areas are considered jurisdictional "waters of the United States" under the Clean Water Act. Boundaries with alkali marsh and wet alkali meadows are typically complex. Areas identified as water may include some vegetated wetland types.

- **Playa.** Essentially barren areas that occur in lacustrine land (Figure 6-2). Soils are gleyed and seasonally saturated. Hydric soil and wetland hydrology are evident, but hydric vegetation is not present. These areas are not wetlands. Boundaries with alkali meadow on lacustrine soils are diffuse. Boundaries with Parry saltbush-Torrey seepweed are also diffuse – areas identified as playa may contain up to 25 percent inclusions of Parry saltbush-Torrey seepweed. Boundaries with other wetland vegetation types are typically abrupt.

- **Intermittently Flooded Playa within the Brine Pool Transition Area.** At the southern end of the Delta Habitat Area, the east and west branches converge. Intermittent, shallow water spreads across the ground surface in broad meandering swaths, terminating in the brine pool. The unvegetated portions of the brine pool transition area with topography suitable for shallow flooding were mapped as intermittently flooded playa; however, standing water was not observed in this area in the September 2000 aerial photograph. Hydric soils and wetland hydrology are evident. Vegetation is mostly absent, except along the border of wetted rivulets. The jurisdictional status of these nonvegetated areas was not considered.

Similar vegetation types were mapped for 1996 (White Horse Associates, unpublished) and 1999 conditions (White Horse Associates, 2000) for the Delta Habitat Area. The areas of wetland vegetation types for 1996, 1999 and 2000 conditions are compared in Table 6-3. Areas of wetland vegetation types and water increased from 645 acres in 1996 to 774 acres in 1999, to about 831 acres in 2000. The upland vegetation types listed in Table 6-3 include rabbitbrush-Nevada saltbush, Parry saltbush, dune, and playa.

They also include alkali meadow on aeolian land and Goodding-red willow series on the low terrace landtype. The area of upland vegetation types decreased to the same extent as wetlands increased.

TABLE 6-3
VEGETATION TYPES MAPPED IN THE DELTA HABITAT AREA – 1996, 1999, AND 2000

Vegetation Type	Potential Jurisdictional Status	1996 Conditions		1999 Conditions		2000 Conditions*	
		(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	Waters of US	6	<1	67	2	7	<1
Vegetated wetland							
Alkali marsh	Wetland	118	3	156	4	192	5
Goodding-red willow	Wetland	22	<1	13	<1	18	1
Wet alkali meadow	Wetland	304	8	320	9	366	10
Alkali meadow	Wetland	196	6	218	6	248	7
Subtotal (Water + Vegetated Wetland)	**Wetland**	**645**	**18**	**774**	**22**	**831**	**23**
Upland	Upland	2,845	80	2,739	76	2,689	75
Intermittently flooded playa within the brine pool transition area	Not considered	88	2	66	2	58	2
TOTAL		**3,578**	**100**	**3,578**	**100**	**3,578**	**100**

Source: White Horse Associates, 2004.
*Preliminary estimates of the acreages of wetland vegetation types from the 2000 aerial photos, as presented in Draft EIR/EIS, were skewed towards the alkali meadow type due to an inconsistency in correlation of the 2000 legend and misinterpretation of the 2000 aerial photos. The acreage values presented above in the Final EIR/EIS reflect the results of field verification and correlation of the 2000 mapping and analysis.

6.1.3.3 Evapotranspiration and Precipitation

Ecosystem Sciences developed a preliminary estimate of water demand in the Delta Habitat Area (Technical Memorandum 8, January 1999, and addenda, 2000). Evaporation from bare playa with thick sand deposits (e.g., the North Flood Irrigation Project adjacent to the Delta) is estimated to be 3.4 inches per year. Clay/crust playa areas have an evaporation rate of about 4.1 inches per year. Evaporation from open water (brine pool transition area) is estimated at 11 inches from of February through May and 25 inches from June through January, for a total of 36 inches.

In vegetated areas, evapotranspiration varies spatially as a function of vegetation cover and species composition and temporally as a function of plant growth stage (i.e., leaf surface area) and complex climatic variables (e.g., wind speed, temperature, humidity). Estimated evapotranspiration rates for vegetation types in the Delta range from 30 to 60 inches per year (Green Book, 1990; Lopes, 1988). Other somewhat different evapotranspiration rates for alkali meadow with low saltgrass cover range from 8 to16 inches per year (Brad Schultz, Desert Research Institute reported in GBUAPCD, 1997) and for alkali scrub from 12 to 19 inches per year (Duell, 1990).

Assuming 5 inches annual rainfall (50-year average at LADWP weather station in Lone Pine), direct precipitation will provide about 1,491 acre-feet per year to the Delta Habitat Area annually. Great Basin Unified Air Pollution Control District (GBUAPCD) measures precipitation at eight stations on or near Owens Lake. Average annual precipitation at these stations ranged from 2.0 to 3.6 inches from 1999 to 2002 (GBUAPCD, 2003a). Since 1999 through 2002 were years with below normal precipitation, LADWP considers the 50 years of data collected at Lone Pine to be more representative of long-term weather conditions. While most of the precipitation falling directly on unvegetated playas, comprising about 39 percent of the Delta Habitat Area, will evaporate, some will run off to augment vegetated wetlands. Direct precipitation on alkali scrub and dune vegetation types, comprising about 35 percent of the Delta Habitat Area, will infiltrate rapidly into the sandy surface soils and is expected to sustain these communities.

6.1.3.4 Historical Perspective of Wetland Development

A historical perspective of changes in the extent of wetlands and waters of the U.S. in the Delta Habitat Area was developed by White Horse Associates from aerial photos. The historical perspective may be useful for interpreting the functional attributes of Delta Habitat Area and processes instigating change. Aerial photos are available for eight periods:

1. 1:24,000 scale black-and-white photos dated October 14, 1944
2. 1:3,300 black-and-white photos dated May 8, 1967
3. 1:12,000 scale color photos dated July 21, 1981 for only the north part of the Delta Habitat Area
4. 1:12,000 scale color photos dated July 26, 1992 for only the north part of the Delta Habitat Area
5. 1:12,000 scale color photos dated July 16, 1993
6. 1:12,000 scale color photos dated August 7, 1996
7. 1:12,000 scale color photos dated April 13, 1999
8. High resolution, digital orthophotos dated September 2000

Aerial photos were scanned and registered to the 2000 digital orthophotos. Wetlands in the Delta Habitat Area were delineated from the 1944 and 1967 images. The 1981 and 1992 aerial photos cover only the north part of the Delta Habitat Area, so the extent of wetlands could not be estimated for those years. The extent of wetlands for 1993, 1996, 1999 and 2000 conditions was estimated from studies conducted by White Horse Associates (1997; unpublished; 2000; and 2004). Historical photos were rectified using common points (e.g., trees, shrubs, roads, stream features) that remained evident on the 2000 digital orthophotos. The Arc-Info Register and Rectify programs were used. Vegetation boundaries are commonly shifted slightly on maps developed from the 1993, 1996, and 1999 aerial photo images. This shift results from distortion inherent to the stereo photos (e.g. tilt, yaw, and parallax) and errors in registering photos during the original mapping (control points were few and far between before the digital orthophotos became available in 2000). The shift has little effect on the area of map polygons. Inflow to the Delta Habitat Area discussed for each period is based on measured discharge at Keeler Bridge, reduced by 1.6 cfs to account for 0.35 cfs per mile loss to evapotranspiration and bed loss along the 4.5 mile reach between the gage at Keeler Bridge and the top of the Delta Habitat Area (Table 6-4).

TABLE 6-4
ESTIMATED AVERAGE INFLOW TO THE DELTA HABITAT AREA FOR SELECTED PERIODS*

Water Years	Average Flow (cfs)		
	Winter (October – March)	Summer (April – September)	Annual
1939-1944	13	5	9
1944-1967	7	3	5
1969-1981	11	4	7
1983-1992	17	6	11
1991-1992	7	3	5
1992-1996	12	10	11
1996-1999	16	10	13
1999-2000	16	9	12
2000-2001	12	4	8

Source: White Horse Associates, 2004; Flow data provided by LADWP.
* Estimated from flows at the Keeler gage, diminished by estimated channel loss between the gage and the Delta Habitat Area (1.6 cfs).

In 1944, there was a relatively continuous strand of seasonally flooded wetland (167 acres) that terminated about 1.6 miles north-northwest of the present-day outlet of the Delta Habitat Area (Figure 6-5). A very narrow extension of the dune along the west side of the channel divided vegetated wetlands from the unvegetated transition to the brine pool (24 acres). Beaver probably reinforced the dune extension. An island of wind-blown (aeolian) sediments was evident in the middle of the reach. Vegetated wetlands included riparian forest and alkali meadow that were seasonally flooded and a few pockets of marsh that were saturated and/or semi-permanently flooded. There was a clearly defined stream draining through most of the vegetated wetland. The stream was diffuse through two marshes, one in the vicinity of what is now the elbow (Figures 6-1 and 6-5) and the other at the lower end of the vegetated wetland. The overflow channel was a small intermittently flooded oxbow that returned to the main channel about 1,500 feet downstream, where an encroaching dune occluded the channel. The sand sheet was present in the north part of area between the present day west and east branches. The average inflow to the Delta Habitat Area for October 1944, the period of the aerial photos, was 3 cfs. Vegetated wetland was overflowing to the brine pool. Average winter (October through March) inflow to the Delta Habitat Area for the previous 5-year period (1939-1944) was 13 cfs, average summer (April through September) inflow was 5 cfs, and total annual inflow averaged 9 cfs. Inflow to the Delta Habitat Area was typically negligible (< 1 cfs) during July, August and September when evapotranspiration demand was highest.

By 1967, the lower extent of vegetated wetlands (42 acres) had retreated about 1.4 miles upstream (Figure 6-6). Dunes encroached along the west flank of vegetated wetland. Vegetated wetlands drained to a broad zone of open water and wet playa (152 acres). Encroaching dunes pushed the outlet to the brine pool (103 acres) about 0.3 miles east and occluded the overflow channel inlet. Vegetated wetlands included seasonally flooded riparian forest and alkali meadow on elevated floodplains and islands surrounded by extensive marsh in lower positions. Beaver channels were evident in the marshes. Inclusions of marsh vegetation and a few widely scattered trees were present in the open water/wet playa complex. The average inflow to the Delta Habitat Area for May 1967, the date of aerial photos, was 6 cfs. The open water/wet playa complex was overflowing to the brine pool. Average winter (October through March) inflow to the Delta Habitat Area for the previous 23-year period (1944-1967) was 7 cfs, average summer (April through September) inflow was 3 cfs, and total annual inflow averaged 5 cfs. Inflow to the Delta Habitat Area was typically negligible (< 1 cfs) during July, August and September when evapotranspiration demand was highest.

The 1981 aerial photos cover only the north part of the Delta Habitat Area (Figure 6-7). The east branch was well established by 1981. Riparian forest that was on high ground in 1967 was now saturated and engulfed in marsh for a distance of about 0.4 miles below the north divergence. The saturated zone of vegetated wetland overflowed to a well-defined channel (the hook) with open water flanked by seasonally flooded meadows on higher ground. The channel dissipated into a myriad of rivulets through alkali meadow about 0.6 miles downstream. Accretion had raised water levels above a low, sandy bank at the inlet to the east branch, where marsh and alkali meadow had established. The average inflow to the Delta Habitat Area for June 1981, the period of aerial photos, was 1.4 cfs. Average winter (October through March) inflow to the Delta Habitat Area for the previous 12-year period (1969-1981)[2] was 11 cfs, average summer (April through September) inflow was 4 cfs, and total annual inflow was 7 cfs. Inflow to the Delta Habitat Area was typically negligible (< 1 cfs) during July, August and September when evaotranspiration demand was highest.

By 1992, (Figure 6-8) the saturated zone had moved at least 0.75 miles downstream, beyond the limits of aerial photo coverage and the east branch was wetter. The average inflow to the Delta Habitat Area in July 1992, the period of the aerial photos, was 3 cfs. Average winter (October through March) inflow for the previous 8-year period (1983-1992)[3] was 17 cfs, average summer (April through September 1991) inflow was 6 cfs, and total average inflow was 11 cfs. Average inflow during July, August and September ranged from 3 to 4 cfs with only a few years when inflow was negligible (< 1 cfs).

White Horse Associates mapped the extent of wetland vegetation types from 1993 photos (Figure 6-9) as part of a baseline LORP inventory that was used to predict future vegetation types (White Horse Associates, revised 1997[4]). Wetland vegetation types (422 acres) included water (36 acres), alkali marsh and wet alkali meadow (125 acres), Goodding red willow (17 acres) and alkali meadow (244 acres)[5]. Mapping from the 1993 photos is somewhat coarse, with inclusions of uplands in areas designated vegetated wetland (e.g., the island of playa in the east branch above the near convergence with the west branch) and inclusions of wetlands in areas designated upland (e.g., very narrow rivulets forming the eastern-most limb of the east branch). The area of designated water included a buffer on the main channel draining the east and west branches, most of which was really vegetated wetland. These aerial photos are dated July 16, 1993, just a week before the experimental LORP flows were released. Average flow at the Keeler gage for July 1993 (35cfs) is skewed by this event. The average inflow for the first half of July 1993, before the experimental flow, was <1 cfs. Although open water was present at its southern limit, vegetated wetland did not overflow to the brine pool. Average winter (October through March) inflow to the Delta Habitat Area for the previous water year (1991-1992) was 7 cfs, average summer (April through September) inflow was 3 cfs, and total annual inflow was 5 cfs.

---

[2] Discharge at Keeler gage for the 1968 water year was about 435 percent of normal and was not considered for this analysis. While the high flows in 1968 influenced the hydrology of the Delta Habitat Area in 1968 (and possibly through 1969), they most likely had little influence on the conditions of the wetlands that were present at the time the aerial photographs were taken in 1981 (10+ years after the high flows occurred) since most of the water is assumed to have passed through and was not used by the plants. The average winter, summer, and annual flows for the <u>1968</u>-1981 period were 21, 40, and 30 cfs, respectively.

[3] Discharge at Keeler gage for the 1982-83 water year was about 678 percent of normal and was not considered for this analysis. While the high flows in 1982-83 influenced the hydrology of the Delta Habitat Area in 1983, they most likely had little influence on the conditions of the wetlands that were present at the time the aerial photographs were taken in 1992 (nearly 10 years after the high flows occurred) since most of the water is assumed to have passed through and was not used by the plants. The average winter, summer, and annual flows for the <u>1982</u>-1992 period were 26, 22, and 24 cfs, respectively.

[4] White Horse Associates (1997) listed 408 acres of vegetated wetland. A map error was corrected, resulting in an additional 14 acres of vegetated wetland reported here.

[5] The nomenclature for wetland/riparian vegetation types used in White Horse Associates (1997) was standardized to that previously discussed for 2000 conditions.

White Horse Associates also mapped the extent of wetland vegetation types for 1996 conditions (Figure 6-10) in a mapping effort that began in 1999. When more recent aerial photos became available in late 1999 this detailed draft mapping from the 1996 aerial photos was abandoned prior to preparation of a report. Wetland vegetation types (645 acres) included water, alkali marsh, wet alkali meadow, alkali meadow and Goodding-red willow. The average inflow to the Delta Habitat Area for August 1996, the date of aerial photos, was 9 cfs. Extensive overflow was occurring from the west branch to the brine pool. Average winter (October through March) inflow to the Delta Habitat Area for the 1992-1996 water years was 12 cfs, average summer (April through September) inflow was 10 cfs, and total annual inflow averaged 11 cfs.

White Horse Associates (2000) also mapped vegetation types in the Delta Habitat Area from aerial photographs dated April 13, 1999 (Figure 6-4). Field descriptions of vegetation, soil and hydrologic parameters were used to assign a wetland status to combinations of landtype and vegetation type following guidelines of the Wetlands Delineation Manual (U.S Army Corps of Engineers, 1987). The total area of jurisdictional wetlands and "waters of the United States" was estimated to be 774 acres (22 percent of the Delta Habitat Area). Similar to 1996, extensive overflow was occurring from the west branch of the brine pool. The average inflow to the Delta Habitat Area for April 1999, the period of aerial photos, was 9.1 cfs. Both the east and west branches were overflowing to the brine pool. Average winter (October through March) inflow to the Delta Habitat Area for the 1996-1999 water years was 16 cfs, average summer (April through September) inflow was 9 cfs, and total annual inflow averaged 12 cfs.

As described in Section 6.1.3.2, White Horse Associates (2004) mapped the extent of wetland vegetation types from the 2000 digital orthophotos (Figure 6-11). Vegetation types similar to those used for the 1996 and 1999 mapping were identified. Landtypes and water-regime modeled after Cowardin, et al. (1979) were also assigned to each polygon. The total area of vegetated wetlands and water identified was 831 acres. The estimated average inflow to the Delta Habitat Area for September 2000, the date of aerial photos, was 11 cfs. Vegetated wetland was overflowing from the west branch to the brine pool. Average winter (October through March) inflow to the Delta Habitat Area for the 1999 to 2000 water year was 16 cfs, average summer (April through September) was 9 cfs, and total average inflow was 12 cfs.

The flow releases to the lower Owens River that began in 1986 (and modified jointly by the County and LADWP in 1989 during the drought) under the "Lower Owens River Rewatering Project" (see Section 2.3.2) will continue until the flow releases proposed under LORP begin (see Section 2.3.5). Therefore, with the exception of emergency or maintenance releases to the river from the Aqueduct, etc., the portion of the flows to the Delta Habitat Area that is being managed by LADWP (i.e., excluding natural runoff) has remained and will remain the same as under existing conditions until the LORP flow releases begin. However, in the past few years, reduction in flows to the Delta has been observed, most likely due to increased water consumption by vegetation growth and impoundment due to beaver activity along the river upstream of the Delta. Nevertheless, during field reconnaissance of the Delta conducted by White Horse Associates in 2001 and 2002, continued expansion of wetlands since 2000 was evident (areas transitional from drier to wetter vegetation types were common).

The extent of vegetated wetlands and water in the Delta Habitat Area for 1944, 1967, 1993, 1996, 1999 and 2000 is summarized in Table 6-5.

TABLE 6-5
WETLANDS AND WATER AREAS IN THE DELTA HABITAT AREA, 1944 - 2000

Year	Wetland and Water* Areas (acres)
1944	167
1967	42
1993	422
1996	645
1999	774
2000	831

Source: White Horse Associates, 2004.
* Excludes the intermittently flooded playa within the brine pool transition area.

6.1.4 Bird Use

The shallow flooded, unvegetated or sparsely vegetated alkali playa provides unique habitat for many resident and migratory waterfowl and shorebirds. When wetted, it provides an abundant invertebrate food supply, fresh water for ingestion and cleaning, and open expanses for sighting predators. The playa within and near the Delta provides greater resources than other playa areas around Owens Lake due to the proximity of freshwater from the river, which supports a greater variety of invertebrate species (food for birds) and provides water for thermoregulation and salt balance for birds.

Shorebirds that utilize the alkali playa in the Delta Habitat Area include western snowy plover, American avocet, black-necked stilt, spotted sandpiper, semi-palmated plover, black-bellied plover, greater yellowlegs, lesser yellowlegs, western sandpiper, whimbrel, least sandpiper, dunlin, marbled godwit, killdeer, willet, and long-billed curlew.

In addition to the shallow flooded areas, the waterfowl that occur in the Delta use various wetland-related habitats, including the marsh and riparian forest along river upstream of the Delta and along the west branch; open water ponds that occur as deep sections along the west channel or as isolated ponds near the east or west branches; and marsh and alkali meadow that occur along the margins of the two main channels in the center of the Delta. Waterfowl species in the Delta area include mallard, northern pintail, gadwall, cinnamon teal, green-winged teal, redhead, northern shoveler, American widgeon, canvasback, ruddy duck, Canada goose, snow goose, and wood duck.

Bird species that occur in marsh areas of the Delta include the American bittern, least bittern, great blue heron, great egret, black-crowned night-heron, Virginia rail, sora, marsh wren, common yellowthroat, red-winged blackbird, and yellow-headed blackbird.

Bird species that utilize the riparian forest and alkali scrub along the Owens River above the “Y” and along the west branch below the “Y” include wood duck, great blue heron, great egret, black-crowned night heron, Cooper's hawk, sharp-shinned hawk, ferruginous hawk, Swainson's hawk, long-eared owl, ash-throated flycatcher, western kingbird, Bewick’s wren, LeConte's thrasher, and loggerhead shrike.

Owens Lake has been identified as important bird habitat in two area-wide planning documents. The U.S. Shorebird Conservation Plan is a collaborative document prepared by a partnership of agencies and organizations throughout the United States committed to the conservation of shorebirds. The Plan outlines conservation goals for each region of the country, identifies critical habitat conservation needs and key research needs, and proposes education and outreach programs to increase awareness. Owens Lake is identified as a key shorebird area of the Intermountain West Region, especially for snowy plover (USSCPC, 2000).

Owens Lake has also been designated an Important Bird Area by the National Audubon Society (Audubon California, 2003). The Important Bird Areas Program works through partnerships to identify places that are critical habitat to birds during some part of their life cycle (breeding, wintering, feeding, or migrating) (National Audubon Society, 2004).

6.1.5 Beaver

A beaver population is present along the river from the proposed pump station site to the "Y," and along the upper third of the west branch where riparian woodland is present. This population has created several large dams along the west branch that have caused backwater effects upstream of the Delta, and have substantially slowed the river flows and caused elevated water levels in the river and west branch for many years. This backwater effect in the west branch appears to divert flows to the east branch where beaver are absent.

6.1.6 Saltcedar

In the Delta Habitat Area, saltcedar are present primarily along the east and west branches. Saltcedar in the Delta area have not formed dense stands as they have elsewhere in the Valley; however, many large trees are present.

6.1.7 Special Status Species

Several special status species utilize the Delta Habitat Area on a year-round or seasonal basis. These species include those listed as threatened or endangered by the state or federal government, or Species of Special Concern (designated by the California Department of Fish and Game). The latter include species that are rare or declining in the state, but are not yet considered threatened or endangered. A list of special status species in the Delta Habitat Area is provided in Table 6-6. Information about the occurrence of selected species is provided below.

Only one threatened or endangered species is known to occur in the Delta Habitat Area. The peregrine falcon is a state endangered species which occurs as a spring and fall migrant at Owens Lake, taking shorebirds in and near the Delta Habitat Area.

The Delta Habitat Area contains suitable nesting habitat for the following threatened or endangered species: black rail (state threatened), bank swallow (state threatened), and Swainson's hawk (state threatened). These species could conceivably breed in suitable portions of the Delta in the future (including the river between the pump station and the Delta proper), with or without the LORP. It appears that two variants of the willow flycatcher occur in Owens Valley – the federal endangered southwestern willow flycatcher and the state endangered willow flycatcher. Both could occur as migrants in the riparian woodlands along the upper portions of the Delta.

The western snowy plover is a state Species of Special Concern that occurs at Owens Lake as a summer breeder and migrant. There is considerable interest amongst local ornithologists in the local population of snowy plovers due to the high numbers of birds and their restricted occurrence on the playas of Owens Lake. Plovers nest in open, sparsely vegetated playas around the margins of the lake from March through July. Nests are located within 1,500 feet of freshwater areas, such as seeps, ponds, and riparian corridors, where birds can forage for brine flies and aquatic invertebrates; ingest freshwater; and thermoregulate.

Plovers feed by gleaning insects off both dry and wet areas, but not in open water or dry sand. Owens Lake supports possibly the largest interior population of the western snowy plover in California. (A separate and distinct population, which the USFWS has identified as a separate "evolutionary significant unit," occurs along the Pacific Coast, which is listed as a federal endangered species.) Recent surveys of the plover throughout Owens Lake by the Point Reyes Bird Observatory from 1999-2001 indicate higher numbers, indicating that the population is larger or that more birds have been observed due to a greater number of surveys in recent years.

TABLE 6-6
SPECIAL STATUS SPECIES THAT MAY USE THE OWENS RIVER DELTA HABITAT AREA

Species	Protection Status	Status in the Delta
Great blue heron	LC	Resident
Great egret	LC	Migrant
Least bittern	SSC	Nesting & foraging
White-faced ibis	SSC	Migrant, spring & fall foraging
Black-crowned night-heron	LC	Spring, fall, and winter migrant
Cooper's hawk	SSC	Spring & fall migrant
Sharp-shinned hawk	SSC	Spring & fall migrant
Golden eagle	SSC	Foraging
Ferruginous hawk	SSC	Winter foraging
Swainson's hawk	ST	Potential nester
Northern harrier	SSC	Resident, nesting & foraging
Osprey	SSC	Migrant
Merlin	SSC	Winter foraging
Prairie falcon	SSC	Year-round foraging
American peregrine falcon	SE	Migrant, winter foraging
Western snowy plover	SSC	Nesting and foraging (see below)
Long-billed curlew	SSC	Potential nester, foraging
California gull	SSC	Spring & fall migrant, winter resident
Black tern	SSC	Migrant, spring & fall foraging
Long-eared owl	SSC	Resident
Vaux's swift	SSC	Migrant
Willow flycatcher*	SE, FE	Migrant
Loggerhead shrike	SSC	Nesting & foraging scrub habitat
Bank swallow	ST	Migrant
Le Conte's thrasher	SSC	Nesting & foraging scrub habitat
Yellow warbler	SSC	Migrant, potential nester
Yellow-breasted chat	SSC	Migrant, riparian nester
Owens Valley vole	SSC	Resident, alkali meadow

SE= state endangered. ST = state threatened. FE= federal endangered. SSC = state Species of Special Concern. LC = Species of local concern. *Includes both willow flycatcher (state listed species) and southwestern willow flycatcher (federal listed species).

No nesting plovers have been recorded within the Delta Habitat Area. However, several nests were recorded in May 2001 in Zone 1 of the North Sand Sheet water spreading area, southwest of the Delta Habitat Area (Figure 6-1). Nests were located within 2,000 feet of the western boundary of the Delta Habitat Area and directly adjacent to the brine pool transition area at the southern end of the Delta Habitat Area. Dozens of nests were also observed in May 2001 in Zone 2 of the Dust Mitigation Program.

No threatened, endangered, or special interest plant species are known to occur in the Delta Habitat Area (Ecosystem Sciences, Technical Memorandum 8, January 1999).

The endangered Owens pupfish and Owens tui chub do not appear to occur in the Delta Habitat Area, although potentially suitable habitat may be present. Ecosystem Sciences (Addendum to Technical Memorandum 8, April 2000) estimated the potentially suitable habitat for these species (1996 conditions) to be a portion of 567 acres (consisting of areas that are dominated by water, including alkali marsh, wet alkali meadow, riparian scrub, open water, and brine pool transition area).

6.2 PROPOSED FLOW REGIME

LADWP's proposed management actions for the Delta Habitat Area consist of three types of flow releases: (1) baseflows; (2) four pulse flows; and (3) bypass of annual seasonal habitat flows. The sum of baseflows and pulse flows will be within the 6 to 9 cfs annual average stipulated in the MOU. Bypass of seasonal habitat flows to the Delta will not be included in the calculation of the 6 to 9 cfs annual average. The proposed flow release regime for the Delta Habitat Area is described in detail in Section 2.4.2.

6.3 POTENTIAL IMPACTS

The impacts of proposed flow management for the Delta Habitat Area are evaluated in the following subsections. The primary issues to be addressed are the effects of the amount and timing of the proposed baseflows, pulse flows, and seasonal habitat bypass flows on existing aquatic and wetlands habitats in the Delta Habitat Area (as of 2000, the most recent reported wetland inventory).

There are many uncertainties in predicting the effects of the proposed flows on wetlands in the Delta due to an incomplete understanding of the complex ecological and hydrologic processes. Uncertainties include: effect of changes in timing of flows on vegetation, effect of changes in the overall magnitude of flow, interaction between surface water and groundwater and resultant effects on salinity in the root zone, effects of wind on landforms, and the magnitude of channel losses from evaporation, transpiration and percolation. In addition, the overall effects on groundwater conditions in the Delta from rewatering the river and from the applications of water to Owens Lake under the Dust Mitigation Program are not completely understood. Reasonable differences of opinion exist amongst technical experts interpreting the same data and are described below. Section 6.3.6 presents the impact determinations for the Final EIR/EIS.

6.3.1 Impact Assessment No. 1 (Prepared by Ecosystem Sciences and White Horse Associates)

The following impact assessment was primarily prepared by staff from White Horse Associates based on their work completed for the "Delta Habitat Area Vegetation Inventory - 2000 Conditions" (White Horse Associates, 2004) in coordination with staff from Ecosystem Sciences.

The total hydrologic input to the Delta Habitat Area includes surface inflow, alluvial groundwater inflow and direct precipitation. The Keeler stream gage, about 4.5 river miles upstream of the pump station, has surface flow readings from 1927 to present. The methods of determining flow at the Keeler gage and potential errors in the results are described in Section 4.3.1. Average monthly flows at the Keeler gage for 1927/28 through 1985/86 and 1986/87 through 2000/01 water years are summarized in Table 6-7. These two periods are shown separately because the preliminary release to the lower Owens River under the "Lower Owens River Rewatering Project" began in 1986 (see also Section 2.3.2). Table 6-8 presents average monthly flows measured at Keeler gage since publication of Draft EIR/EIS in November 2002. These average monthly flows must be viewed with reservation. Monthly flows prior to March 1990 appear to be based on a measure of flow for a single day that was then assigned to all other days of the same month. While most monthly flows since March 1990 represent the average of daily measures, similar extrapolations of flows for a single day to all days of a month are apparent in some years. In addition, the accuracy of flow measurements at Keeler gage is reduced when the measuring station is inundated due to nearby beaver activities; at these times, LADWP hydrographers estimate flows.

TABLE 6-7
AVERAGE MONTHLY FLOWS AT THE KEELER GAGE
1927/28 – 2000/01 WATER YEARS

Month	1986/87-2000/01 Water Years* (cfs)				1927/28-1985/86 Water Years (cfs)			
	AVG	MAX	MIN	SD	AVG	MAX	MIN	SD
OCT	11	22	6	5.6	13	241	1	36.9
NOV	14	21	8	4.5	11	160	3	21.1
DEC	14	22	8	4.3	19	272	4	38.8
JAN	15	20	9	3.2	21	295	4	41.5
FEB	16	22	9	3.4	31	356	5	65.2
MAR	16	31	8	5.7	36	493	1	84.8
Winter Avg =	14	21	8	3.8	22	214	4	36.7
APR	12	21	6	4.7	37	503	3	87.7
MAY	9	21	3	5.2	17	293	3	47.3
JUN	5	12	1	3.0	39	1,080	1	171.3
JUL	8	35	0	8.1	35	1,002	0	155.8
AUG	10	28	0	6.4	20	428	0	78.0
SEP	10	21	2	5.3	7	130	0	21.0
Summer Avg =	9	14	2	3.3	26	501	2	90.5
Annual =	12	15	5	3.1	24	306	3	58.5

Source: File of average monthly flows provided by LADWP. Prepared by White Horse Associates.
Note: Flows recorded prior to 1990 appear to be based on a measure of flow for a single day that was then assigned to all other days in the same month.
* Preliminary release to the lower Owens River commenced in 1986.

TABLE 6-8
AVERAGE MONTHLY FLOWS AT THE KEELER GAGE
2001/02 AND 2002/03 WATER YEARS

Month	2001/02 Water Year (cfs)	2002/03 Water Year (cfs)
OCT	13	7
NOV	15	11
DEC	12	12
JAN	13	12
FEB	13	16
MAR	13	11
Winter Avg =	13	12
APR	11	8
MAY	6	5
JUN	3	2
JUL	3	1
AUG	7	21
SEP	4	8
Summer Avg =	6	8
Annual =	9	9

Source: Keeler gage data collected by LADWP.

Average winter flows at the Keeler gage for the 1927-1986 period (22 cfs) were highly variable, ranging from 4 to 214 cfs. Maximum average monthly flows for this period were in March, while minimum average monthly flows were in March and October. Average summer flows for the period (26 cfs) were higher and more variable (2 to 500 cfs). Maximum average monthly flows were in June and July while minimum average monthly flows were in June, July, August and September.

In 1986, a preliminary release to the lower Owens River commenced. Average winter flows for the 1986-2001 period (14 cfs) were less variable than for the 1927-86 period, ranging from 8 to 21 cfs. Maximum average monthly flows for this period were in March and minimum average monthly flows in October. Summer flows averaged 8.9 cfs, ranging from 2 to 14 cfs. The maximum average monthly flow in July corresponds with preliminary experimental releases to the Owens River in 1993. Minimum monthly flows of less than 1 cfs occurred inJuly and August.

Flow to the Delta Habitat Area can be estimated by subtracting the estimated losses along the 4.5-mile long reach of the river between the Keeler gage and the pump station. Based on a channel loss estimate of 0.35 cfs (see Section 10.5), the estimated loss from the Keeler gage to the pump station would be 1.6 cfs.

Alluvial groundwater inflow to the Delta Habitat Area is expected to increase in response to re-watering of the Owens River. The magnitude of future groundwater inflow has not been estimated.

As discussed in Section 6.1.3, between 1944 and 1967 the extent of vegetated wetlands in the Delta Habitat Area decreased from about 167 to 42 acres, possibly a response to negligible summer inflows (< 1 cfs). Since 1993, the extent of vegetated wetlands and water has increased from 422 to 831 acres in 2000

(Table 6-3), possibly related to more consistent summer inflows. As shown in Chart 6-1, there is a highly significant correlation ($r^2 = 0.98$) between time (years since 1992) and the extent of vegetated wetlands, showing an average increase of about 61 acres per year. The regression equation is:

$$Y = 58.1X + 371$$

Where: Y = acres of wetland and waters of U.S.
and
X = number of years since 1992

A similarly significant correlation ($r^2 = 0.97$) was found between area of wetlands and average discharge for the previous calendar year (Chart 6-2). The regression equation is:

$$Y = 0.068X + 62.3$$

Where Y = acres of wetland and waters of the U.S.
and
X = average discharge (acre-feet) the previous year

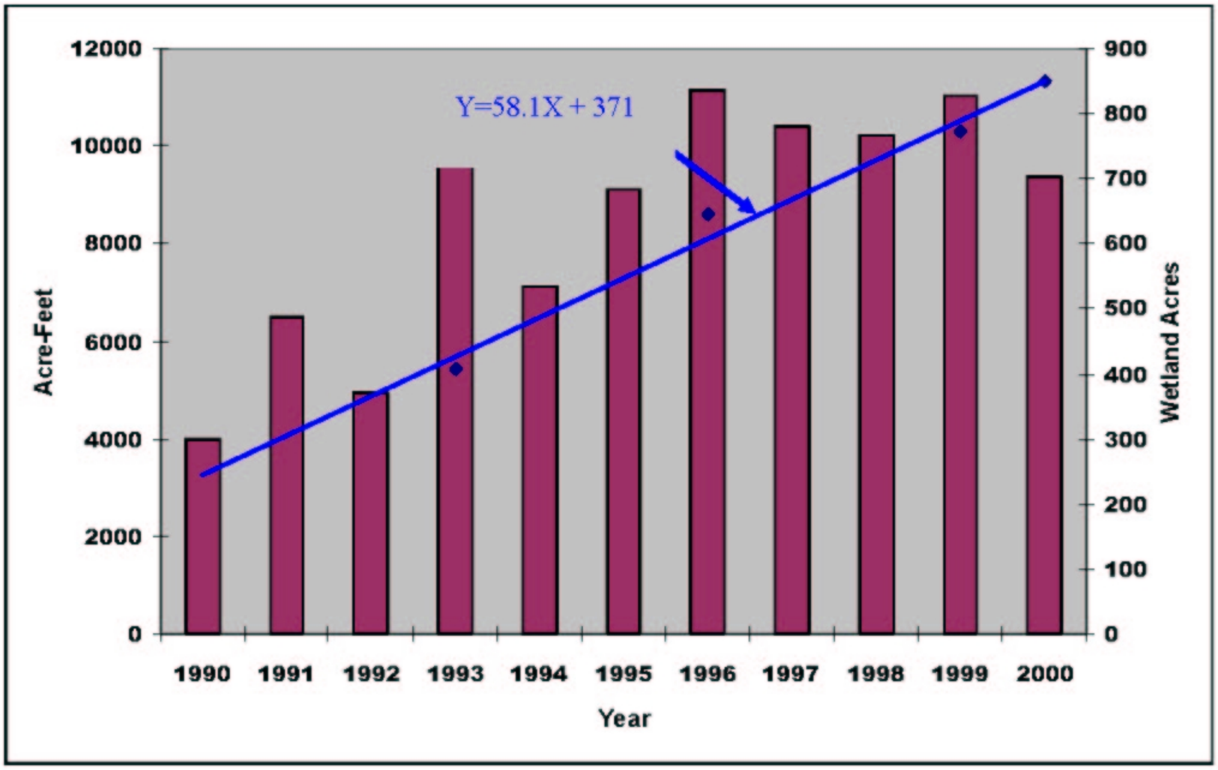


Chart 6-1. Areas of wetlands for 1993, 1996, 1999 and 2000 versus time.

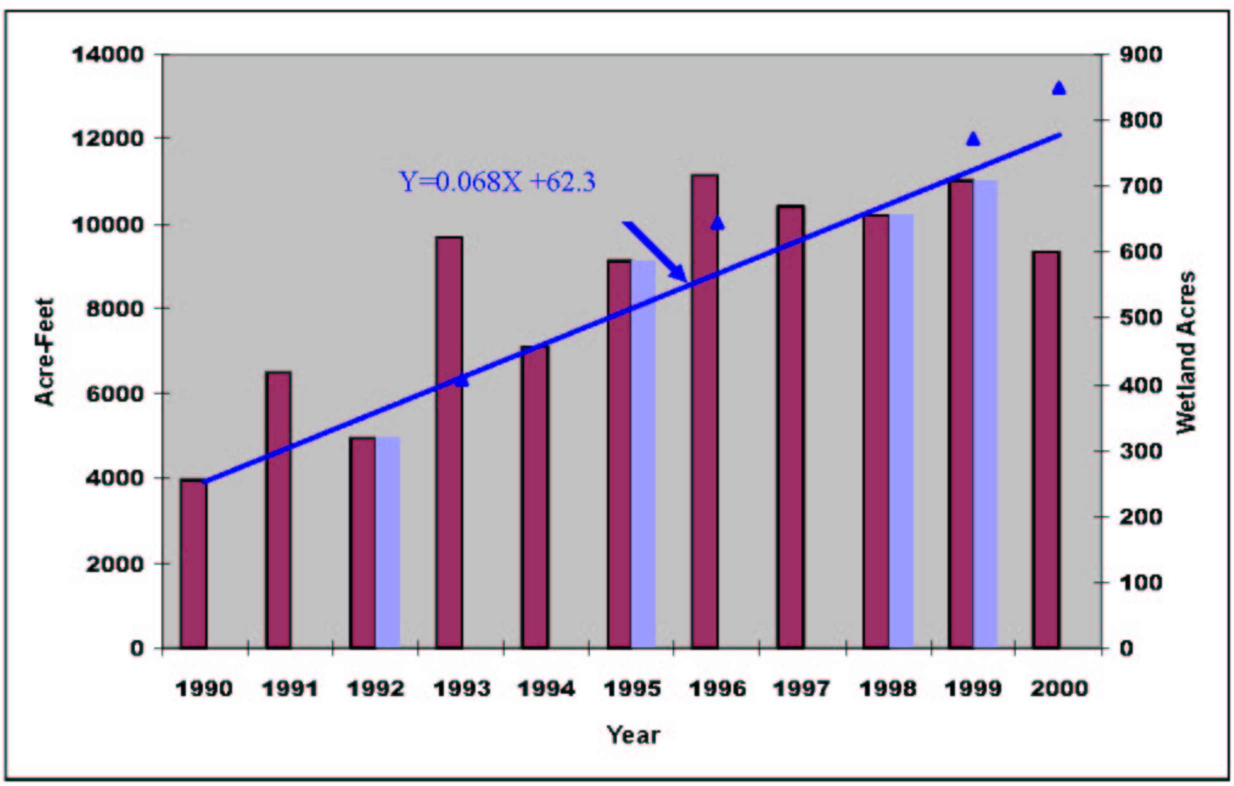


Chart 6-2. Areas of wetlands for 1993, 1996, 1999 and 2000 versus previous year.

These results are somewhat confounding to an understanding of the mechanisms responsible for the consistent expansion of wetlands since 1993, leading White Horse Associates to two hypotheses:

- **Hypothesis 1:** The same expansion of wetlands would have occurred with higher or somewhat lower inflows, as long as inflow met the evapotranspiration demand of wetland vegetation types that existed for the period.
- **Hypothesis 2:** Wetlands would have expanded more with higher average annual inflows and would have shrunk with lower inflows.

Continued expansion of wetlands since 2000 was evident during field reconnaissance of the Delta in 2001 and 2002 (areas transitional from drier to wetter vegetation types were common), yet average annual inflow to the Delta Habitat Area decreased from 12 cfs in 1999-2000 to 8 cfs in 2000-2001 (see Table 6-4). While these observations seem to contradict hypothesis 2, they do not preclude alternative hypotheses that the seasonality of inflow (e.g., summer) is most important for wetland expansion, but regressions of wetland area (1993-2000) and several measures of seasonal inflow (e.g., summer inflow for the current and previous water year) were not significant.

The expansion of wetlands since 1967 appears to correspond to a subtle rise in the saturated surface. By 1981, seasonally flooded riparian forest vegetation that was on high-and-dry ground in 1967 was permanently flooded and water had overflowed into the east branch. The rise in the saturated surface is believed to result from both beaver activity and the accretion of organic matter, especially in the wettest vegetation types. The continued rise in the saturated surface is evident in the steady expansion of vegetated wetlands from 1993 to 2000. As vegetated wetlands expand, water is spread over a broader area, the amount of water storage in the Delta Habitat Area increases, and the rate of flow-through decreases.

When inflow exceeds water storage and plant utilization, the Delta Habitat Area overflows to the brine pool. This overflow to the brine pool is a good indication that the water needs of existing wetlands are being met and that storage capacity has been exceeded. Extensive overflow to the brine pool is evident on the August 1996, April 1999 and September 2000 aerial photos (Figures 6-10, 6-4 and 6-11, respectively) when average inflow to the Delta Habitat Area ranged from 8.7 to 9.5 cfs. This indicates that inflow to the Delta Habitat Area exceeded storage and evapotranspiration demand for those periods. Given about 50 percent higher winter inflow (Table 6-7) and lower winter evapotranspiration demand, it can be surmised that more extensive outflow occurred during winter months.

It is unlikely that water overflowing to the brine pool either serves to maintain existing vegetated wetlands or influences expansion of vegetated wetlands in the Delta Habitat Area. Impounded drainage “overflowing” to the brine pool is evident for 1944, 1967, 1996, 1999 and 2000 summer and spring conditions when evapotranspiration demand was highest. It is a misconception that permanently flooded and saturated wetlands and open water will “drain” to the brine pool if inflows are reduced to the point where no outflow to the brine pool occurs – open water and marsh are evident in 1993 when there was no overflow to the brine pool. Dr. Ron Ryel, Ecosystem Sciences (undated memo), modeled the hydrology of the Delta Habitat Area as a pool that fills to capacity, and then overflows in response to higher flows.

These observations lend credence to Hypothesis 1 that a similar expansion of vegetated wetlands would have occurred with higher or lower average annual inflows to the Delta Habitat Area as long as the evapotranspiration demand of existing vegetated wetlands was met. They also serve to refute Hypothesis 2 that vegetated wetlands would have expanded more or less in response to different average annual inflows.

Baseflow Impacts

The extent of vegetated wetlands in the Delta Habitat Area has increased about 2,000 percent since 1967 (Figures 6-4 through 6-11; Table 6-3). Wetlands have expanded at a steady rate of about 61 acres per year between 1993 and 2000, when about 831 acres of vegetated wetlands and water existed in the Delta Habitat Area. Continued expansion of wetlands since 2000 was evident during field reconnaissance of the Delta conducted by White Horse Associates staff in 2001 and 2002 – areas transitional from drier to wetter vegetation types were common. Based on the trend in wetland growth since 1993, the area of wetlands in the Delta Habitat Area is expected to continue to increase for some time, but eventually level off when the evapotranspiration demand of the vegetation resource exceeds inflow and direct precipitation.

The expansion of wetlands is believed to result from the subtle rise in surface and alluvial groundwater levels resulting from beaver activities and accretion of organic matter, which is dependent upon inflow meeting storage and evapotranspiration demands. As wetlands expand, the amount of water storage in the Delta increases and the rate of flow-through decreases. When inflow exceeds evapotranspiration demand, storage, and infiltration, the Delta overflows to the brine pool. Monitoring of a stream gage to be established at the outlet of the Delta Habitat Area will be used the first year following completion of the pump station to fine tune baseflows for all monitoring periods and to calibrate and refine predictive models. Given that baseflows will be adjusted to maintain 0.5 cfs outflow from the Delta Habitat Area at least initially, it is expected that the "Delta conditions" will be maintained within the confines of 6 to 9 cfs annual average flow stipulated in the MOU. Under the proposed initial release regime, it is likely that flows to the Delta will be lower in the winter (over existing conditions) when evapotranspiration is low, and higher in the summer (over existing conditions) when water demand is high. Based on field observations by LADWP staff and review of aerial photographs, there is generally no outflow from the Delta in the summer under existing conditions.

The predicted impacts of baseflows to vegetation resources in the Delta Habitat Area are:

- Loss of unvegetated playa that will be converted to vegetated wetland types and open water
- Conversion of drier wetland vegetation types to wetter vegetation types and open water
- Possible accelerated loss of vertical structure associated with the Goodding-red willow (riparian forest) vegetation type which is expected to die and not regenerate naturally.

An increase in the areal extent of vegetated wetlands is anticipated, as barren playa is converted first to alkali meadow and later to wet alkali meadow in response to a slow and steady rise in groundwater level due to accretion of vegetation. The riparian forest that established in the Delta Habitat Area under seasonally flooded conditions in the past has since been inundated by the steady rise in groundwater level. As described in Section 6.1.3.2, trees are decadent or dead and are not reproducing under existing conditions. Under both existing conditions and under the proposed flow regime, conditions favorable for propagation of riparian forest (Goodding-red willow) (i.e. seasonally or intermittently flooded, sparsely vegetated substrate) are not expected to return unless flows to the Delta are first eliminated for a long enough time to eliminate vegetated wetlands, then reinstated under different water management. By providing more consistent flows in the summer when trees are biologically active and hence maintaining consistent low oxygen levels in the root zone, the proposed baseflows could accelerate the loss of riparian forest and, consequently, accelerate loss of vertical structure. A total of about 18 acres of decadent riparian forest identified in 2000 (White Horse Associates, 2004) are expected to be replaced by water and marsh.

Pulse Flow Impacts

Pulse flows will be established to replenish the freshwater lens, to enhance vegetation production during critical periods, and to provide unique habitat for selected wildlife. Studies by GBUAPCD and Schultz (1993) indicate that recharge of the freshwater lens overlaying the saline groundwater may be important during winter months. Depletion of the freshwater lens during the growing season, without replenishment prior to spring runoff, could expose plant roots to toxic levels of saline water as they come out of dormancy in March and April. The pulse flows are expected to fully recharge the freshwater lens by providing flows large enough to overflow to the brine pool (i.e., inflow to the Delta exceeds evapotranspiration demand and storage capacity, including the freshwater lens). By providing additional water at critical times of the year, pulse flows are also expected to enhance wetlands expansion, not through direct short-term expansion of a wetted zone, but rather through promotion of more vigorous wetland vegetation that will serve to increase roughness, slow water velocities, increase residence time, and contribute to accretion of organic matter responsible for rising effective groundwater levels.

The adequacy of pulse flows for replenishing the freshwater lens, enhancing vegetation, and providing critical habitat will be evaluated during the monitoring and adaptive management phase. The presence of wetland vegetation is one indicator that the salinity of the shallow groundwater has not exceeded wetland plant tolerances (i.e., freshwater lens is being replenished). Adjustments to pulse flows will be founded on the observed response in the Delta Habitat Area and will be made within the 6 to 9 cfs average annual flow stipulated in the MOU (see Section 2.10.5 and Section 2.4.2.2).

Pulse flows are expected to enhance the health and vigor of wetlands, enhancing production resulting in the rise of effective water level and further expansion of wetlands. Pulse flows will serve to accelerate impacts (relative to 2000 conditions) previously discussed with respect to baseflows.

Seasonal Habitat Flow Impacts

Without considering channel losses, seasonal habitat flows that will bypass the pump station to the Delta Habitat area would range up to 150 cfs every other year on average. Impacts to the Delta from the bypass of seasonal habitat flows are expected to include:

- Discharge to the overflow channel inlet when inflows are above 50 cfs, enhancing conditions for expansion of intermittently flooded vegetated wetland in this area.
- Flooding of lower parts of the east branch that are currently intermittently flooded alkali meadow.
- Increased seepage under the dunes to isolated wetlands west of the west branch.
- Inundation of upland habitats along the edges of vegetated wetlands.

Hydrologic modeling conducted by Dr. Ron Ryel, Ecosystem Sciences (Appendix E), indicates that under existing channel conditions, flows above 50 cfs could top the overflow channel inlet and may open the channel to more consistent surface flow. The inlet to the overflow channel is in a straight reach that is confined (by aeolian sediments) immediately upstream. The probability of the overflow channel capturing more than a small part of flow to the Delta Habitat Area is small. Surface discharge in the overflow channel is confined by dunes in the immediate vicinity of the overflow channel inlet, by a sand sheet further west, and ultimately by a dike along the west flank of the Delta Habitat Area. Hence, the probability of the overflow channel capturing the major flow to the Delta Habitat Area is further diminished.

The current conditions in the overflow channel resemble conditions that existed in the east branch prior to 1981. It is likely that vegetated wetlands associated with the overflow channel will expand in response to rising effective water levels, even without seasonal habitat flows. The area west of the west branch that could be wetted by the overflow channel is an asset where further expansion of vegetated wetlands is likely to occur. Given the dunes along the west side of the west branch, it appears unlikely that surface flow in the overflow channel will return to the west branch (although existing subsurface flow along the sand/playa interface will continue), as is the apparent trend to the myriad of rivulets constituting the east branch.

Flooding of the lower parts of the east branch that are currently intermittently flooded alkali meadow for the short duration (±10 days) is expected to invigorate saltgrass production. Given that saltgrass spreads primarily by extension of stolons, short-term expansion of the extent of alkali meadow is expected in response to seasonal habitat flows.

Seepage of groundwater under the dunes that border the west branch is expected to enhance isolated wetlands that exist where the sand sheet is thin (see Figure 6-2). Similar to that discussed above, the extent of alkali meadow may increase in this area in response to seasonal habitat flows.

Flooding may also occur in areas outside the existing vegetated wetlands, resulting in intermittently flooded playa and alkali scrub vegetation types. Flooding of these areas for up to 10 days every other year is not expected to change these upland vegetation types to vegetated wetlands. Infrequent, intermittent flooding of upland vegetation types may cause an influx of weeds.

Additional effects on the Delta from the bypass of seasonal habitat flows are expected to be:

- Potential increase in weeds in upland areas that are flooded by seasonal habitat flows
- Potential stranding of fish in flooded portions of the Delta Habitat Area
- Undesirable accumulation and concentration of salts in intermittently flooded uplands that may inhibit survival of existing vegetation
- Potential stranding of fish in the western branch
- Undesirable accumulation and concentration of salts in small depressions that are flooded every 2 to 5 years (Ecosystem Sciences, Addendum to Technical Memorandum 8, April 2000)

Impact Summary Related to Delta Habitat Area

For purposes of the EIR/EIS, impacts were assessed relative to 2000 conditions (White Horse Associates 2004). In this study it was estimated that approximately 831 acres of water and vegetated wetlands existed in 2000. The proposed water budget is expected to result in further expansion of vegetated wetlands relative to 2000 conditions. Wetlands expansion is expected to continue until evapotranspiration demands exceed baseflow and the expansion of wetlands levels off. Further wetlands expansion may occur in response to pulse flows. Vigorous wetland vegetation will result in more efficient use of available water (e.g., increased transpiration and reduced evaporation). Except for the brine pool transition area as described in Section 6.3.5, no adverse impacts to the extent of water and vegetated wetlands as compared to 2000 conditions are anticipated.

The MOU specifies "riparian areas and ponds" will be enhanced and maintained "to the extent feasible." Given static conditions, all open water in the Delta Habitat Area would eventually be converted to marsh. But conditions in the Delta Habitat Area since 1944 (see Section 6.1.3) have not been static. Shifting dunes and beaver are important dynamic forces that create new areas of open water that will eventually revert to vegetated wetland. Intensification of these forces is expected to cause a short-term shift towards more open water and less vegetated wetlands. Reduction of these forces is expected to cause a long-term shift towards less open water and more vegetated wetlands. However, please note that implementation of

LORP is not expected to affect the extent, distribution or dynamics of dunes. At this time, beaver management is not proposed in the Delta Habitat Area, but is a potential adaptive management measure as described in Section 2.10.5..

Anticipated beneficial impacts resulting from implementation of baseflow, pulse flows, and bypass of seasonal habitat flows include: (1) conversion of unvegetated playa to vegetated wetlands; and (2) conversion of drier wetland types to wetter vegetated wetland types and open water. Anticipated adverse, but less than significant, impacts resulting from implementation of baseflows include the accelerated loss of vertical structure associated with the riparian forest wetland type. Existing riparian forest areas developed under historical seasonally flooded conditions and have been reduced to small areas of decadent, dying and dead trees that are permanently flooded or saturated.

Determination of the significance of Delta flow regime changes on Delta aquatic and wetland habitats is presented below in Section 6.3.6.

6.3.2 Impact Assessment No. 2 (Prepared by URS)

An alternative opinion on the potential effects of the proposed flow regime on aquatic and wetland habitats in the Delta is described in the following subsections. The following analyses were prepared by URS Corporation, consultant to Inyo County, during preparation of the Draft EIR/EIS:

- Anticipated changes in the amount of water available to the Delta as a result of the proposed baseflows and pulse flows (Section 6.3.2.1)
- Potential for seasonal habitat flows to reach the Delta (Section 6.3.2.2)
- Ecological effects of reduced flows to the Delta (Section 6.3.2.3)
- Potential for flows to bypass the Delta in a channel that occurs outside the Delta (Section 6.3.2.4)
- Potential for water to spread laterally through the Delta under different flow conditions (Section 6.3.2.5)

These analyses are then used to determine if the proposed flow regime will enhance aquatic and wetland habitats by evaluating the underlying ecological mechanisms in the Delta.

6.3.2.1 Amount of Water Reaching the Delta From Proposed Baseflows and Pulse Flows

The goals of the MOU are intended to be achieved, in part, by improving flow management to the Delta using an average annual flow of 6 to 9 cfs, including four pulses of higher flows to increase water spreading for specific wetland and avian needs. LADWP proposes establishing the Delta baseflow regime during the first year after the pump station is completed (see Section 2.4.2), thus actual Delta baseflows to be implemented under the LORP are unknown at this time, although they will be an annual average of 6 to 9 cfs as required by the MOU. For the purposes of this analysis, Delta baseflows are assumed to be an average annual flow of 7.1 cfs, with daily flows of 5.3 cfs plus the four pulse flows and potential additional flows due to the seasonal habitat flows that are bypassed to the Delta. This flow amount is considered a reasonable estimate for the purpose of analysis because (1) it was the flow regime initially proposed by Ecosystem Sciences in Technical Memorandum 8 (January 1999) and addenda (April and June 2000), (2) it is within the MOU-required range of 6 to 9 cfs, and (3) it is the initial flow release that LADWP will use to establish baseflows. The following analysis evaluates whether an average annual flow of 7.1 cfs will represent an increase over the flows to the Delta that were occurring in 1996 when the MOU was signed, as well as under current conditions. The ecological impact of the change in flows is addressed in Section 6.3.2.3.

There are no stream gages at the north end of the Delta. However, the LADWP stream gage at Keeler Bridge, about 4 river miles upstream of the pump station, has flow readings from 1927 to the present. The methods of determining flow at the Keeler Bridge and potential errors in the results are described in Section 4.3.1. Major conclusions from the analysis include the following:

- Flows at Keeler Bridge are derived from releases from upstream spillgates that reach the river, runoff from precipitation and snowmelt, and groundwater baseflows. A major source of recharge to the shallow groundwater is likely to be water released from upstream spillgates. The high variability in flows among and within years is largely explained by the fact that flows are manipulated by upstream water management actions.

- Groundwater baseflows that reach Keeler Bridge were estimated to be about 4 cfs by Inyo County in 1986 (Hutchison, 1986).

- The median monthly flows at Keeler Bridge during the period 1986-2001 when LADWP began releasing water from upstream spillgates for the Lower Owens River Rewatering Project (a precursor to the LORP) range from 5 to 17 cfs (Chart 4-4).

- Flows at Keeler Bridge are low in the summer and high in the winter (Chart 4-4). One explanation for this pattern is that flows are dominated by groundwater discharge from the valley, which would be depressed in the summer due to evapotranspiration. Precipitation and runoff also contribute to the annual variations in flow.

Flows at Keeler Bridge for various time periods are summarized in Table 6-9. Median and average flows between 1986 and 1996 were both about 11 cfs. Slightly higher flows have been occurring since 1996. Median monthly flows were about 7 cfs. Median monthly flows over the entire period of record were 7.8 cfs. Without the two flood years of 1938 and 1969, median monthly flows were 7.1 cfs. Average monthly flows were higher.

TABLE 6-9
SUMMARY OF EXISTING AND PROPOSED FLOWS AT KEELER BRIDGE AND BELOW THE PUMP STATION LOCATION

Period of Record	Median Monthly Flow (cfs)*	Average Monthly Flow (cfs)*	Median Annual Discharge (acre-feet)
Measured Flows at Keeler Bridge			
1986-2001 (baseline conditions for impact assessment)	12.2	11.8	8,833
1986-1996 (baseline conditions for MOU)	11.1	11.2	8,036
1927-2001 (available historic data)	7.8	21.7	5,647
1927-2001, minus 1938-39, 1969-70 flood flows which skew the average data (column 2)	7.1	13.6	5,140
Estimated Flows to the Delta (pump station location)			
1986-2001 (baseline conditions for impact assessment), calculated by subtracting 1.4 cfs channel loss from measured flows at Keeler Bridge	10.8	10.4	7,819
Proposed Flows to the Delta (pump station location)			
Proposed baseflows and four pulse flows (average annual flows); see Table 2-11.	~7.1 average annual	7.1 average annual	5,140

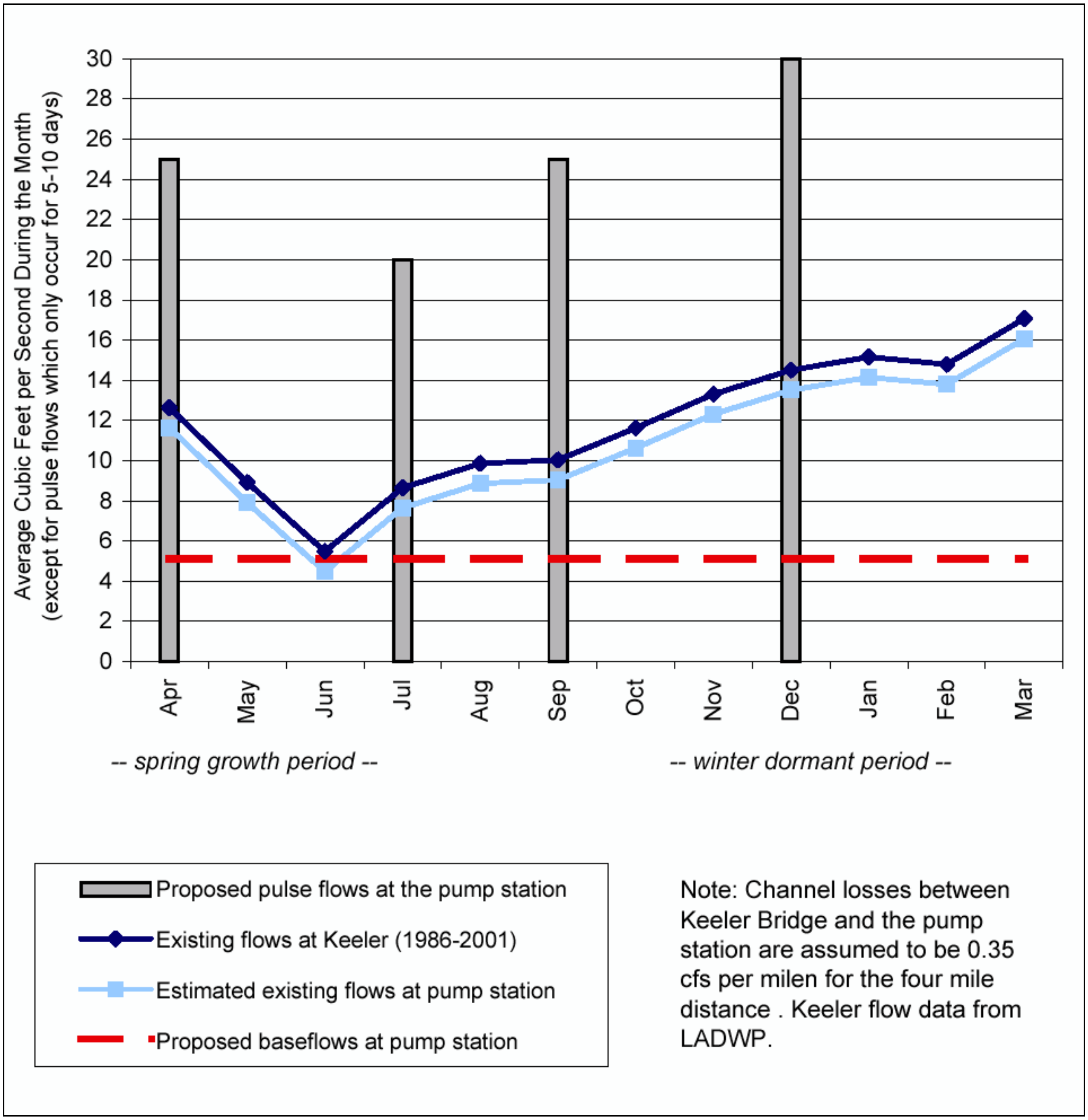
Source: Spreadsheet provided by LADWP June 2000. *Monthly flows based on daily measured flows. 1 cfs = 724 acre-feet per year, 1.98 acre-feet per day.

Flows at the pump station site were estimated by subtracting the estimated losses along the 4-mile long reach of the river between Keeler Bridge and the pump station site. As described in detail in Section 10.5, the losses during steady state conditions are estimated to be about 0.35 cfs per mile. Based on this value, the estimated loss from Keeler Bridge to the pump station would be 1.4 cfs. Hence, the median and average flows at the pump station site from 1986 to 2001 are estimated to be about 11 cfs and 10 cfs, respectively.

Based on this analysis, it appears that the proposed initial annual average baseflow of 7.1 cfs at the pump station site would be about 35 percent less than the current and recent historic flows of about 11 cfs. In essence, the required average annual flows of 6 to 9 cfs are already being achieved, and exceeded, under current operations. Implementation of the LORP, as proposed, would reduce baseflows to the Delta to 6 to 9 cfs from about 10 cfs. The relationship between the estimated existing flows to the Delta and the proposed baseflows is shown on Chart 6-3.

An average initial annual flow of 7.1 cfs would result in less water being discharged to the Delta on an annual basis. As shown in Table 6-9, the current (i.e., during the period of 1986-2001) estimated median annual discharge to the Delta is about 7,819 acre-feet. Under the 7.1 cfs annual average flow regime, the total initial annual discharge would be about 5,140 acre-feet. The ecological consequences of the overall reduction in flows to the Delta over current and recent historic conditions are described in Section 6.3.2.3, taking into consideration the seasonality of the proposed pulse flows and the effects of the seasonal habitat flows.

CHART 6-3
EXISTING (1986-2001) AND PROPOSED FLOWS AT PUMP STATION SITE



6.3.2.2 Potential for Seasonal Habitat Flows to Reach the Delta

Release Regime for Seasonal Habitat Flows from the River Intake

Seasonal habitat flows would be released from the River Intake during most years, as described in Section 2.3.5.3. The maximum amount of the annual seasonal habitat flow would be determined each year based on predicted runoff conditions. No habitat flows will be released in dry years, but the amount of the flow would increase in accordance with runoff predictions up to a maximum of 200 cfs in average and above average runoff years. The seasonal habitat flows would be established each February by the Standing Committee, in consultation with the California Department Fish and Game using LADWP's Runoff Forecast Model for the Owens Valley. The maximum flow of 200 cfs would be released every other year on average. Over the long-term, the average annual seasonal habitat flow would be 150 cfs at peak release (Randy Jackson, pers. comm., 10-4-01).

The amount of water released from the River Intake for the seasonal habitat flows will be ramped up from the 40-cfs baseflow to reach the peak flow and back down to the baseflow rate in accordance with a specified ramping schedule described in Section 2.3.5.3, as well as shown on Chart 2-2. The number of days of flows above the 40-cfs baseflow will range from 1 day for a 50-cfs peak flow, to 6 days for a 75-cfs peak flow, to 14 days for a 200-cfs peak flow. Seasonal habitat flows will be ramped up starting from the 40-cfs baseflow to achieve the specified seasonal habitat flow magnitude for that year. For example, if a seasonal habitat flow of 200 cfs is specified, flows will increase 160 cfs on top of the 40-cfs baseflow to achieve a peak magnitude of 200 cfs.

The seasonal habitat flows will be released from the River Intake and will not be augmented by water released from spillgates downstream of the River Intake. Thus, seasonal habitat flows released at the River Intake would be subject to channel losses, described below and in Section 10.5. As a consequence, seasonal habitat flows above the 40-cfs baseflows would be depleted as they travel from the River Intake to the pump station. In contrast, the 40-cfs baseflow would be supplemented by spillgate releases to ensure approximately 40 cfs reaches the pump station.

Estimated Channel Losses for Seasonal Habitat Flows

Loss rates along the Lower Owens River were estimated by Inyo County (Jackson, 1994) based on several different methodologies. The primary method relied upon the observed losses during the experimental flows to the lower river in 1993. Channel losses (herein defined to include loss to alluvial aquifer and evapotranspiration) based on *instantaneous* stream flow measurements was estimated to average 0.79 cfs per mile, with a range of 0.49 to 1.53 cfs per mile. he *mean* channel loss along the river throughout the experiment were estimated to average 1.3 cfs per mile, with a range of 0.15 to 3.68 cfs per mile. Percolation is likely to be less than in 1993 if the flows in the river result in filling of the alluvial aquifers along the river over time. However, the evapotranspiration rate will increase over time as riparian vegetation cover increases.

Jackson (1994) also estimated evapotranspiration losses along the river by estimating average evapotranspiration of existing riparian vegetation types located along the river, multiplied by the area of the vegetation adjacent to the river. Based on this method, the evapotranspiration rate along the river under current conditions is about 0.2 cfs per mile. This method of estimating total channel loss does not include channel losses to deeper aquifers or lateral groundwater movement, nor does it take into account the increased evapotranspiration expected to occur along the river as new riparian vegetation increases. Rewatering the river is expected to increase riparian vegetation productivity and areal extent. As a conservative approach, it is estimated that the channel losses, consisting primarily of evapotranspiration, during steady state conditions along the river would be twice the calculated evapotranspiration of current vegetation, or about 0.4 cfs per mile.

Based on the above information and other estimations of channel losses (described in more detail in Section 10.5.1), it is estimated that channel losses (including percolation and evapotranspiration) during the initial rewatering (years 1 and 2) would be at least 1 cfs per mile. Channel losses from baseflows during steady state conditions are expected to be about 0.35 cfs (similar to observed losses downstream of Keeler Bridge), or slightly higher. The basis for this estimate is described in detail in Section 10.5.1. This is considered a very low or conservative estimate of steady state losses, as indicated in recent discussions with Inyo County (Randy Jackson, pers. comm., 10/1/01). LADWP recently estimated the channel losses along the river to be about 0.75 cfs based on flow measurements during the removal of beaver dams (B. Tillemans, pers. comm.). Nevertheless, the 0.35 cfs per mile loss rate is used for the analysis of losses during steady state conditions.

Seasonal habitat flows of up to 200 cfs may experience higher channel losses than baseflows because: (1) flows across the floodplain may encounter depressions where water could be detained, resulting in higher evaporation and percolation than in the channel; and (2) flows across the floodplain may encounter more dewatered storage conditions in the alluvium compared to the channel banks. No empirical data on channel losses during high flows are available. However, in the absence of such data, the estimated channel loss rate during seasonal habitat flows is estimated to be the same as channel losses during initial rewatering – 1 cfs per mile. The actual annual loss due to seasonal habitat flows will vary depending upon the maximum flow required based on the forecasted runoff in the valley, as well as climatic conditions, soil conditions, and aquifer conditions.

Recognizing the difficulty in predicting the channel losses during the seasonal habitat flows, a lower loss rate is also used in the following impact analysis identical to the predicted baseflow channel loss – 0.35 cfs per mile. However, the actual rate could be different than the estimate.

Estimated Seasonal Habitat Flows Reaching the Pump Station and Delta

The estimated amounts of water that would be bypassed to the Delta during a 200-cfs seasonal habitat flow are shown in Table 6-10 with a moderate channel loss assumption, and Table 6-11 with a lower channel loss assumption.

During a seasonal habitat flow of 200 cfs, flows of 12 to 88 cfs would be bypassed to the Delta for 5 days (totaling about 358 acre-feet above the baseflows) using a moderate channel loss rate estimate of 1 cfs per mile (Table 6-10). These bypass flows would occur in average and above average runoff years, or about every other year on average.

TABLE 6-10
ESTIMATE OF SEASONAL HABITAT FLOWS THAT REACH THE PUMP STATION
MODERATE CHANNEL LOSS ASSUMPTION

Day	Flows at the River Intake (Flows Prior to Day 1 are 40 cfs)		Seasonal Flows that Reach the Pump Stn After 62 cfs Channel Loss*	Total Flows at Pump Stn	Flows to the Delta During Seasonal Habitat Releases	
	Flow (cfs)	Seasonal Flows Above 40 cfs			Flows** (cfs)	Acre-feet above Baseflows***
1	50	10	0	40	5.3	0
2	63	23	0	40	5.3	0
3	79	39	0	40	5.3	0
4	99	59	0	40	5.3	0
5	124	84	22	62	12	13
6	155	115	53	93	43	75
7	200	160	98	138	88	164
8	160	120	58	98	48	85
9	128	88	26	66	16	21
10	102	62	0	40	5.3	0
11	82	42	0	40	5.3	0
12	66	26	0	40	5.3	0
13	53	13	0	40	5.3	0
14	40	0	0	40	5.3	0
Total quantity of water that reaches the Delta (acre-feet)=						358

1 cfs for one day = 1.98 acre-feet. * The estimate of channel loss is 1 cfs per mile. See text for explanation.
** Minimum daily baseflows to the Delta assumed to be 5.3 cfs. *** Does not include volume of water associated with 5.3 cfs baseflow.

Using a lower channel loss rate estimate of 0.35 cfs per mile, flows would be bypassed to the Delta for 9 days (totaling about 857 acre-feet above the baseflows), with flows of 7 to 128 cfs being released to the Delta during the 9-day ramping period (Table 6-11).

TABLE 6-11
ESTIMATE OF SEASONAL HABITAT FLOWS THAT REACH THE PUMP STATION
LOWER CHANNEL LOSS ASSUMPTION

Day	Daily Average Flows at the River Intake (Flows Prior to Day 1 are 40 cfs)		Seasonal Flows that Reach the Pump Stn After 22 cfs Channel Loss*	Total Flows at Pump Stn	Flows to the Delta During Seasonal Habitat Releases	
	Flows (cfs)	Seasonal Flows Above 40 cfs			Flows** (cfs)	Acre-Feet above Baseflows***
1	50	10	0	40	5.3	0
2	63	23	1	41	5.3	0
3	79	39	17	57	7	3
4	99	59	37	77	27	43
5	124	84	62	102	52	92
6	155	115	93	133	83	154
7	200	160	138	178	128	243
8	160	120	98	138	88	164
9	128	88	66	106	56	100
10	102	62	40	80	30	49
11	82	42	20	60	10	9
12	66	26	4	44	5.3	0
13	53	13	0	40	5.3	0
14	40	0	0	40	5.3	0
Total quantity of water that reaches the Delta (acre-feet)=						857

1 cfs for one day = 1.98 acre-feet. * The estimate of channel loss is 0.35 cfs per mile. See text for explanation. ** Minimum daily baseflows to the Delta assumed to be 5.3 cfs. *** Does not include volume of water associated with 5.3 cfs baseflow.

Hence, the total initial annual discharge to the Delta would range from 5,498 to 5,997 acre-feet. This estimate is based on 5,140 acre-feet released to the Delta from initial baseflows and from pulse flows, and a 200-cfs release at the River Intake. The flows to the Delta would be about 2,000 to 2,300 acre-feet per year less than the current (i.e., during the period 1986-2001) median annual discharge to the Delta (7,819 acre-feet).

6.3.2.3 Ecological Effects of Reduced Flows to the Delta

The magnitude and significance of the impacts of the proposed flow regime to the Delta on aquatic and wetland habitats are discussed in the following subsections based on the previous technical analyses concerning the amount of water discharged to the Delta, the channel capacity, and the potential for water spreading.

Mechanisms for Maintaining and Enhancing Delta Wetlands and Aquatic Habitats

In general, the desired benefits to habitats and habitat indicator species in the Delta due to new flow management would be achieved by one or more of the physical and biological mechanisms listed below. The occurrence and relative importance of each mechanism is directly related to the amount and timing of flows to the Delta Habitat Area.

- Mechanisms to Expand Wetlands. Properly managed flows could spread across areas that are not typically inundated. These flows could infiltrate or evaporate, and provide fresh water to the root zone of plants to support new growth or fill pore space to prevent upwelling of saline groundwater, which inhibits plant growth. These conditions may develop new wetlands, if conditions are favorable, as well as expand existing wetlands along their margins. An increase in vegetated wetlands would provide more opportunities for shelter, foraging, and nest sites for most of the waterfowl and riparian breeding birds that use the Delta.

- Mechanisms to Increase Wetland Growth. Properly managed flows could facilitate greater plant productivity by providing more volume of fresh water in the root zone, and/or a longer duration of available water to extend the growing season where it is limited by water. Wetlands in the floodplain of the Delta and riparian habitats along the east and west branches would benefit. An increase in wetland and riparian productivity would provide more opportunities for shelter, foraging, and nest sites for most of the waterfowl and riparian breeding birds that use the Delta.

- Mechanisms to Expand Aquatic Habitat. Properly managed flows could spread across areas that are not typically inundated, creating seasonal or semi-permanent ponds. The flows may also create more open water area within the east and west branches due to higher water surface elevations, and in the brine transition zone at the southern end of the Delta Habitat Area. An increase in open water in the channels and in isolated ponds would directly benefit various shorebirds and waterfowl that use the Delta, including the snowy plover, by creating more food and water.

- Mechanisms to Promote Sustainability. Properly managed flows could increase habitat diversity by causing more physical disturbance in the Delta channels due to higher velocities, more overbank flooding and spreading, and disturbance to beaver dams along the river upstream of the Delta. Increased physical disturbance would likely increase plant recruitment and succession, which in turn would increase sustainability of the ecosystem.

The GBUAPCD has conducted studies on shallow groundwater conditions and vegetation response to groundwater with varying depths and salinities. In addition, the GBUAPCD has conducted several studies on shallow groundwater conditions in and near the Delta. Through these studies, the GBUAPCD has postulated the following explanation for groundwater and wetland conditions in Owens Lake.

Owens Lake is underlain by a shallow groundwater aquifer that is highly saline. It is recharged from winter runoff, and as such, rises each winter. The shallow groundwater is too saline for plant growth. Hence, once it reaches the root zone, plant growth is precluded. In most areas of the lake, there is a gradient of increasing salinity from the groundwater to the surface due to capillary action from evaporation. The Delta contains a freshwater “lens” that occurs above the shallow saline groundwater that is maintained by the discharges to the Delta from the Owens River. The freshwater lens essentially floats above the saline groundwater due to its lower density, and mixing appears to be minimal. In contrast to other areas of Owens Lake, salinity decreases from the depth to the ground surface due to this freshwater lens. Plants thrive in these areas because they are protected from the highly saline groundwater. If the freshwater lens is depleted during the growing season and not replenished prior to the spring runoff, plants rooted in these areas will be exposed to potentially toxic levels of saline groundwater as they break dormancy in March and April.

Based on the above observations, it appears that spreading fresh water in the sparsely vegetated floodplain of the Delta would generally contribute to wetland growth in the Delta by filling pore spaces in the upper soil with fresh water that can be exploited by colonizing wetland plants, and by creating positive pressure from freshwater infiltration that could displace saline groundwater around the margins of the Delta. In general, any additional water to the Delta has the potential to benefit wetlands (by improving soil salinity conditions) and/or birds (by maintaining aquatic habitat and associated invertebrates).

Effect on Existing Aquatic and Wetland Habitats

Aquatic habitats and wetlands in the Delta are directly affected by the amount and timing of flows to the Delta. For these habitats to be maintained in their current conditions, the proposed flow regime to the Delta must: (1) be similar to current and recent historic flows; or (2) provide water resources in different, but more efficient manner compared to the current regime.

As described above, the proposed bypass flows to the Delta would discharge about 35 percent less water to the Delta than under current release regimes unrelated to the LORP. Under current conditions (i.e., the period 1986-2001), 7,819 acre-feet of water (median annual flow) is discharged to the Delta, following a pattern of low flows in the summer and higher flows in the winter (Chart 6-3). Under the proposed initial release regime, there would be a lower baseflow year-round and four discrete 5 to 10-day periods of higher flows. The total initial annual discharge to the Delta would range from approximately 5,498 to 5,997 acre-feet assuming annual average flows of 7.1 cfs released to the Delta. This estimate is based on 5,140 acre-feet released to the Delta from initial baseflows and from pulse flows, plus a 200-cfs seasonal habitat flow release at the River Intake (less channel losses). The additional flows to the Delta under this alternative would be closer in magnitude to the current (i.e., during the period 1986-2001) median annual discharge to the Delta of 7,819 acre-feet, but would still be 1,822 to 2,321 acre-feet per year less. Based on monitoring of the outflow, flow releases may be increased or decreased during the first year and therefore the total annual average discharge may be greater or less than the range described above.

The reduction in the overall amount of fresh water discharged to the Delta may result in adverse impacts to existing aquatic habitats and wetlands. The lower flows could reduce the total volume of fresh water in the root zone, which is critical in maintaining plant productivity in this highly saline soil environment by providing positive pressure in the upper soil to prevent upwelling of highly saline groundwater. The overall reduction in fresh water in the Delta could also reduce the amount of water available for plant uptake, thereby reducing the growth period compared to current conditions. Finally, the reduction in the overall amount of water discharged to the Delta may reduce the water depth in channels and the amount of surface water in seasonal and semi-permanent ponds and in the brine transition zone, which in turn would reduce aquatic habitat for fish, invertebrates, and water-associated birds. The reduction in water surface elevation in the Delta channels could also reduce the extent of lateral groundwater infiltration that supports wetlands along the margins of the channels.

The magnitude of potential adverse impacts of a net reduction in water discharged to the Delta on the condition of existing habitats cannot be accurately predicted. The amount and timing of flows under the proposed flow regime are substantially different compared to the current regime, and as such, an ecological effect (positive or negative) is anticipated. The proposed pulse flows follow the current seasonal flow pattern – that is, low flows in the summer, increasing through the winter, then decreasing in the spring (Chart 6-3). This flow pattern may or may not be optimal for aquatic habitats and wetlands. For example, the proposed lowest pulse flow would occur in the summer (see Chart 6-3) at the time when plants exhibit the highest water demand. In contrast, the high pulse flow in the early winter may fill depleted pore spaces in the soil with freshwater that can be readily used by plants when they break dormancy in the early spring.

It is important to recognize that the seasonal pattern of existing flows is not designed to maintain or enhance habitats in the Delta. The pattern shown in Chart 6-3 is a result of upstream releases for irrigation purposes and channel losses prior to reaching Keeler Bridge. Hence, the lower flows to the Delta in the summer are likely due to high upstream water demand, and should not be considered an optimal flow pattern for maintaining and enhancing wetlands in the Delta. Alternative pulse flow regimes designed specifically to benefit wetlands are described in Section 11.0.

There are no available data or analytic tools to definitively conclude that the revised regime would maintain existing aquatic and wetlands habitats. In contrast, there is a reasonable basis for postulating an adverse effect based on a substantial net reduction in flows to the Delta. Hence, absent compelling evidence to the contrary, it is concluded that a substantial reduction in the total amount of water released to the Delta may have an adverse ecological impact, even in light of the four pulse flows designed for ecological purposes. The proposed flow regime could possibly reduce the extent of existing aquatic and wetland habitats, and the productivity of vegetated wetlands.

It should be noted that a large fraction of the freshwater flows to the Delta pass through to the brine pool. Hence, one can postulate that existing flows can be reduced without adverse ecological effects because not all of these flows may contribute to aquatic and wetland habitats. For example, Ecosystem Sciences (Tables for the Addendum to Technical Memorandum 8, June 2000) estimated that water demand from existing wetlands in the Delta (as of 1996) to be about 3,366 acre-feet per year, well below the approximately 8,000 acre-feet per year discharged to the Delta under current conditions. Hence, some of the water currently discharged to the Delta may not have any ecological consequences within the designated boundary of the Delta Habitat Area.

An alternative viewpoint is that water that is not consumed by plants in the Delta has other benefits, which may not be obvious. For example, maintaining water levels in the Delta channels can provide positive groundwater pressure in areas adjacent to the channels, thereby increasing the height and volume of fresh water to support wetland plants in adjacent areas. The water in channels provides aquatic habitat for invertebrates and birds. The surface area of this habitat and the quality of the water could be adversely affected by a reduction in flow (and the associated reduction in water depth).

The reduction in flows to the Delta under the proposed flow regime can be fully offset by increasing the magnitude of the proposed baseflows and pulse flows, as well as modifying the number and timing of the pulse flows. If the average annual flows to the Delta are increased to the MOU specified maximum of 9 cfs, an additional 1,376 acre-feet would be discharged to the Delta during the year. With this modification, the total annual discharge to the Delta (including baseflows, pulse flows, and seasonal habitat flows) would be 6,874 to 7,372 acre-feet per year. This modified flow amount would likely avoid the impacts to Delta habitats despite being less than current flow amounts because the timing and amount of pulse flows can be adjusted over time through the monitoring and adaptive management program to meet habitat needs with less water.

Hence, the impact of reduced baseflows to the Delta is considered a potentially significant, but mitigable impact. The impact may be effectively mitigated by increasing the average annual flows to the Delta from 7.1 cfs to 9 cfs. Implementation of Mitigation Measure D-1 through the monitoring and adaptive management program would ensure that the existing aquatic and wetland habitats of the Delta are maintained. The impacts to aquatic and wetland habitats due to the reduction in overall water to the Delta could also be mitigated in part, by increased flows to the Delta during the seasonal habitat flows. An alternative to provide more water to the Delta from seasonal habitat flows is described in Section 11.0. Mitigation Measure D-1 was defined by URS as follows:

> Under the proposed monitoring and adaptive management program, LADWP shall make adjustments to the amount and timing of the baseflows and pulse flows up to an average annual flow of 9 cfs to reduce any possible adverse effects on the extent and condition of existing aquatic and wetland habitats in the Delta Habitat Area.

[Although presented in the Draft EIR/EIS as a Mitigation Measure, the actions described in D-1 are included as part of the project description for LORP (see Section 2.10.5). Adaptive management includes adjustments to baseflows and pulse flows up to an annual average of approximately 9 cfs. Therefore, D-1 is not identified as a Mitigation Measure for adoption by LADWP in the Final EIR/EIS.]

6.3.3 Potential for Bypass Flows to be Conveyed Away from the Center of the Delta

The river channel downstream of the pump station is clogged with cattails and bulrushes, facilitated by the low gradient of the river, the current flow regime, and the presence of several beaver dams. To determine if there is sufficient capacity in this channel to convey the seasonal habitat flows that would reach the Delta, LADWP measured six cross sections between the pump station site and the "Y" where the east and west branches diverge (Figure 6-1). The channel width ranges from 200 to 300 feet. The channel depth ranges from 2 to 4 feet.

Ecosystem Sciences conducted a hydraulic modeling analysis (HEC-RAS model) of this reach of the river (using measured cross sections at the transects described above) to determine channel capacity and water surface elevation (Appendix E). The analysis was completed using various flows (7.2, 25, 50, and 150 cfs) to represent different possible bypass flows to the Delta. The modeling assumed a range of gradients and roughness coefficients in order to represent current channel conditions with dense vegetation and a cleared channel.

There is a low-lying area along the western bank of the river channel, about 900 feet upstream of the "Y" (Figure 6-1). The bank appears to have been manually breached to allow flows from the river channel to move to the west. This overflow point is about 20 to 30 feet wide, and about 3 to 4 feet deep. It appears that periodic high flows are conveyed through the breach to form the overflow channel. Under most flows, it appears that the overflow channel only receives seepage flows. However, when the water surface elevation is increased in the river, due to higher flows or effects of beaver dams, surface water spills through the overflow point into the overflow channel. The water surface elevation during a site survey in August 2001 was only 1 foot below the top of the breach, when flows in the river were estimated to be 5 to 10 cfs.

The modeling results by Ecosystem Sciences were designed to identify what magnitude of flows would be likely to overtop the breach in the bank, and be conveyed into the overflow channel. The results are summarized below in Table 6-12. These modeling results indicate that flows between 25 and 50 cfs would overtop the bank and enter the overflow channel.

It is possible that the proposed winter pulse flows of 30 cfs could be partially diverted to the overflow channel. During flow releases by LADWP in August 2001 (for Aqueduct cleaning purposes) of up to 30 cfs, LADWP observed (from a helicopter) surface water in the overflow channel. No ground observations were made at the time; hence, it is uncertain if the flows in the overflow channel were derived from seepage or flows from the river channel.

TABLE 6-12
SUMMARY OF MODELED BREAKOUT FLOWS TO THE OVERFLOW CHANNEL

Flows (cfs) along the River Below the Pump Station	Will the Flows Overtop the Bank with a Clogged Channel?	Will the Flows Overtop the Bank with a Cleared Channel?
7.2	No	No
25*	No	No
50*	Yes	No
150*	Yes	No

Source: Ecosystem Sciences (unpublished data). *Flows above 25 cfs would occur for 3 to 7 days during the maximum seasonal habitat flows of 200 cfs (see Table 6-10 and Table 6-11). In addition, flows of 25 cfs will be released for 10 days during Period 1 and Period 3 pulse flows, and flows of 30 cfs will be released for 5 days during the Period 4 pulse flow (see Section 2.4.2).

Under the proposed seasonal habitat flow releases to the Delta, a peak flow of 88 to 128 cfs is predicted to bypass the pump station when 200 cfs is released from the River Intake (see Table 6-10 and Table 6-11). Based on the results of the HEC-RAS model described above, if these flows overtop banks over time, there is a potential for a large fraction of the river flows to be diverted to the west and outside the Delta Habitat Area (Figure 6-1). Continual flows to the overflow channel could cause a shift in the river, resulting in most of the river flows being diverted from the main Delta to the overflow channel. The latter is isolated from the main Delta area by a 10 to 20 foot high natural sand dune system. Hence, flows in the overflow channel are not likely to return to the main Delta area. As a result, an unknown portion of the seasonal habitat flows would not reach the center of the Delta.

The diverting of flows could result in the degradation of aquatic and wetland habitats in the center of the Delta over time. It is likely that these habitats would be replaced through natural colonization and succession processes along the new overflow channel. However, there may be a lag time for full replacement of habitat functions, which could affect wildlife populations. Eventually, the new habitats would likely be similar to those in the center of the Delta. However, it is not certain that the acreage of the new habitats would be the same as the original habitats because the landforms west of the Delta differ greatly from the center of the Delta. Hence, there is a potential for a net overall reduction in the areal extent of aquatic and wetland habitats due to flows being conveyed west of the Delta through natural hydraulic processes.

It should be noted, however, that release of flows higher than the maximum modeled flow (i.e., 150 cfs) has occurred in the river without causing substantial flows to breakout to the overflow channel. For example, in 2003, LADWP released flows in excess of 200 cfs from the Alabama Spillgate into the river due to a thunderstorm event that plugged the Aqueduct and required emergency releases from the Aqueduct to conduct repairs. This emergency release did not result in diversion of substantial flows to the overflow channel. Therefore, the probability that a large fraction of the flows to the Delta would be captured by the overflow channel may be lower than is indicated by the results of the HEC-RAS modeling.

Upon implementation of the project, LADWP does not propose to physically increase the channel capacity by excavating the channel or raising the western banks along the river upstream of the Delta. LADWP would allow flows to create new channels over time in response to hydrologic and physical conditions in the Delta, and allow habitats to respond to such natural changes. However, as described in Section 2.10.5, adjusting baseflows and/or pulse flows to the Delta (within the 6 to 9 cfs annual average) and/or physically increasing channel capacity are potential adaptive management measures that could be implemented if triggered by the exceedance of thresholds described in Section 2.4.2.2. With implementation of these adaptive management measures, **the potential diversion of flows from the center of the Delta is considered a less than significant impact (Class III)**.

6.3.4 Extent of Anticipated Water Spreading in the Delta from Seasonal Habitat Flows

In order to expand wetlands and create more aquatic habitat in the Delta, the additional flows to the Delta must exceed the capacities of existing channels and swales, and spread to areas that are not typically inundated. The following assessment of water spreading in the Delta assumes that the majority of the seasonal habitat flows do not break out to the western overflow channel described above. To assess the potential for flows to spread across the Delta, LADWP measured cross-sections in two transects across the center of the Delta Habitat Area. The length of each transect was 3,580 feet and extended across the entire Delta Habitat Area. The cross-sections were surveyed on May 9, 2001 when the flow in the Delta was measured at 5.5 cfs. Elevation data were collected to the nearest 10^{th} of a foot. The elevation data indicate the following:

- Under these low flows (5.5 cfs), the water in the west branch creates a wide wetted surface (1,000 feet or more), consisting of connected braided channels and isolated ponds connected by subsurface flow.
- The depth of the water under the low flows was about 1.5 feet. However, there are occasional in-channel "ponds" where the channel invert may be 3 to 4 feet deep.
- Not surprisingly, the topographic relief in the Delta is very low. The difference between the lowest point in the Delta where water is present and the highest point in the center of the area is only about 2 feet.
- The dunes on the west side of the Delta are about 5 to 6 feet high and represent a substantial barrier to flows. There is no topographic break on the east side, where the Delta slopes upward at a very small gradient. The high elevation at the eastern boundary of the Delta Habitat Area is only about 1.5 feet higher than the lowest point in the east branch.
- Under these low flows, water was not present in the east branch, and the difference in invert elevations between the two branches was about 1.5 feet. This indicates that the west branch is still the primary conveyance through the Delta and that the east branch is receiving much less flow at the "Y".
- The non-wetland playa between the two branches is only about 2 feet higher than the west branch invert. Hence, a rise in water surface elevation in the west branch of more than 2 feet could spread across the center of the Delta.

Dr. Ron Ryel conducted HEC-RAS modeling of the flows in the Delta using the two measured transects described above, and transects extrapolated from the field data for the remainder of the Delta. The modeling was conducted to determine water surface elevation and potential spreading under bypass flows of 50 and 150 cfs. The modeling assumed a range of river gradients and three roughness coefficients to represent different channel conditions (Ecosystem Sciences, unpublished data). The modeling analysis is appropriate for a screening level analysis. The modeling results indicated the following:

- The predicted water depth in the Delta channels would increase with a 50 cfs flow. The predicted increase is moderate (about 65 percent), which would translate into water depths of about 2.5 feet compared to conditions observed in May 2001 when water depths were about 1.5 feet with flows of about 5.5 cfs. Water depths observed in May 2001 are predicted to double under a 150 cfs flow, to about 3 to 4 feet. Existing channel depths in the Delta range from 1 to 4 feet; hence, if flows reach the Delta (estimated to be for up to 3 to 7 days), the projected increase in water depths under 50 and 150 cfs would cause flows to break out of the east and west branches in the Delta and spread over adjacent playa and alkali meadow areas.

- The width of the wetted channel would increase at a substantially higher rate than water depth and velocity as flows spread across the flat Delta. The width of the wetted channel would increase about 150 percent with a 50-cfs flow compared to 5-cfs baseflows, which would translate into a new wetted channel of up to about 2,500 feet. Significantly wider flows would be observed under a 150 cfs flow. There could be up to a 400 to 500 percent increase in the flow width, resulting in a wetted area of up to about 4,000 feet. The total width of the Delta (in the center) is about 5,000 feet.

- Velocities would increase at a much lower rate compared to water depth and width. Predicted velocities under all flows and channel conditions would be less than 0.5 feet per second, well below any scouring thresholds.

- The presence of dense in-channel vegetation when flows of 50 and 150 cfs are released to the Delta would cause slightly greater water depths and wetted channel widths, and slightly lower velocities.

In conclusion, the modeling results indicate that flows of up to 50 cfs and 150 cfs (if flows of that magnitude were to occur) would exceed the capacities of the existing west and east branches. The depth and areal extent of spreading cannot be accurately predicted based on the limited modeling conducted to date, but it appears that areas would be subject to shallow flows and flooding during these flows, particularly from 150 cfs flows.

Under the proposed flow regime, seasonal habitat flows would be bypassed to the Delta for 5 days to 9 days with peak flows of 88 to 128 cfs (see Table 6-10 and Table 6-11). These flows would be sufficient to result in water spreading in the Delta.

The modeling results described above also suggest that the four pulse flows to the Delta of 20 to 30 cfs would also flood new areas outside the existing wetted channels, although they would affect a much smaller area than the 50 or 150 cfs flows that were modeled.

6.3.5 Impacts to the Intermittently Flooded Playa within the Brine Pool Transition Area

The area at the southern end of the Delta Habitat Area where the east and west branches converge is generally referred to as the brine pool transition area (located between the vegetated portion of the Delta Habitat Area and the Owens Lake brine pool to the southwest). This area is intermittently flooded with shallow water spreading across the ground surface in broad meandering swaths; in contrast to the vegetated areas of the Delta to the north, the area is unvegetated or sparsely vegetated. As described in Section 6.1.3.2, mapping from aerial photographs indicates that the areal extent of this intermittently flooded playa in the brine pool transition area is approximately 58 acres, or approximately 2 percent of the total Delta Habitat Area (September 2000 conditions). [Note, these are 58 acres with topography suitable for shallow flooding; however, standing water was not present in this area as observed in the September 2000 aerial photograph].

When wetted, this area serves as habitat for waterfowl, wading birds, and shorebirds by providing invertebrate food supply, fresh water for ingestion and cleaning, and open expanses for sighting predators. Species observed in this area include western snowy plover, American avocet, black-necked stilt, spotted sandpiper, semi-palmated plover, black-bellied plover, greater yellowlegs, lesser yellowlegs, western sandpiper, whimbrel, least sandpiper, dunlin, marbled godwit, killdeer, willet, and long-billed curlew.

Based on field observations and review of aerial photographs by LADWP staff, outflow from the Delta Habitat Area is currently absent or minimal during summer. During the months of October to April, there is greater outflow since evapotranspiration demand is substantially less during the winter than during the summer growing season. The specific monthly and seasonal patterns of baseflows to the Delta under the proposed project cannot be determined until baseflows are established through outflow monitoring during the first year. However, since baseflows to the Delta Habitat Area will be managed to minimize outflow, the project is likely to decrease the volume of water reaching the brine pool transition area and, consequently, reduce the extent of sheet flow in the intermittently flooded playa habitat area during the months of October to April relative to existing conditions. This reduction will be partially offset by the releases of Period 1 pulse flow (25 cfs for 10 days in March or April) and Period 4 pulse flow (30 cfs for 5 days in November or December), which are expected to create an overflow to the brine pool transition area (in part for the benefit of wintering birds).

The area of the Delta brine pool transition area that would be affected by the project is small relative to the amount of similar habitat that is currently available in close proximity, i.e., the shallow flooding areas of the Owens Lake Dust Mitigation Program (see Section 12.3). In December 2001, LADWP began shallow flooding 11.9 square miles (7,639 acres) in an area along the northeast part of Owens Dry Lake referred to as Zone 2 (northeastern portion of the lake, immediately adjacent to the Delta Habitat Area; see Figure 6-1). By 2003, the Dust Mitigation Program included 15.4 square miles (9,823 acres) of shallow flooding. Shallow flooding areas are operated between October 1 and June 30 each year. In addition, as part of the CDFG Streambed Alteration Agreement for dust control activities in the southern portion of the lake, LADWP has committed to maintaining 1,000 acres of shorebird habitat within Zone 2 shallow flood area and up to 1,000 acres of additional shorebird habitat using naturally occurring water.

Surveys conducted by the Point Reyes Bird Observatory (PRBO) indicate that the number of shorebirds in the dust control shallow flooding areas have increased since flooding began, presumably due to the increase in brine flies and other insects associated with these areas. The total number of adult snowy plovers observed at the Owens Lake have increased from 167 in 2001, 272 in 2002, to 401 in 2003 (surveys conducted in May; PRBO, 2003). The largest population increase (15 in 2001, 152 in 2002, and 224 in 2003) was observed in the Zone 2 shallow flooding area of the dust control project (PRBO, 2003). In contrast, the number of adults observed within the Delta was 4 (approximately 2 percent of total) in 2001, 17 (6 percent) in 2002, and 20 (5 percent) in 2003, respectively (PRBO, 2003). Results of PRBO surveys in 2003 also indicate that over 90 percent of American avocets and over 70 percent of waterbirds are observed in the Zone 2 shallow flooding area; less than 1 percent of the total numbers of American avocets and waterbirds were observed in the Delta (PRBO, 2003). Based on the relative amount of similar habitat areas and number of birds currently present in the dust control areas and the Delta Habitat Area, project-related reduction in the intermittently flooded playa within the brine pool transition area would affect a very small portion of shorebird habitat available and overall population numbers present within the Owens Lake area as a whole.

Within the context of existing conditions in the Delta and the overall increase of shallow flooded playa habitat types created under LORP, the potential reduction in this type of habitat within the Delta brine pool transition area is considered less than significant. As described in Section 7.1, under the proposed project hundreds of acres of shallow flooded areas will be developed within the Blackrock Waterfowl Habitat Area. Overall, habitat for waterfowl, wading birds, and shorebirds (including the species currently present in the Delta brine pool transition area) will be increased after implementation of LORP.

6.3.6 Impact Summary

As described above, there are many uncertainties in predicting the effects of the proposed flows on wetland and aquatic habitats in the Delta. Due to the limited availability of reliable data (including information needed to accurately estimate existing flows into the Delta), there is incomplete understanding of the complex ecological and hydrologic processes.

Based on the analysis presented in Sections 6.3.1 (Impact Assessment No. 1 prepared by Ecosystem Sciences and White Horse Associates), 6.3.3, 6.3.4, and 6.3.5, LADWP, as CEQA lead agency, has determined that **impacts to existing aquatic and wetland habitats of the Delta would range from beneficial to less than significant (Class III).** LADWP concurs with the model of the Delta presented in Impact Assessment No. 1 which describes the Delta as a basin that fills to capacity then overflows and, consequently, that the water needs of existing vegetation (including and evapotranspiration and freshwater in the root zone) are met if there is an outflow from the Delta. Since the proposed baseflows will be established to ensure a minimal amount of outflow from the Delta throughout the first year (thereby exceeding the water demands of the Delta wetlands that exist at that time), per LADWP's analysis, the proposed baseflows will be sufficient to at least maintain the vegetated wetlands that exist at the time of project initiation. The release of the four pulse flows and the bypass of seasonal habitat flows would provide higher flows (thereby spreading water over a larger area than under baseflow conditions) at key times of the year to enhance vegetated wetlands and aquatic habitats.

The analysis presented in Section 6.3.2 (Impact Assessment No. 2 prepared by URS) was considered. However, LADWP does not concur with Impact Assessment No. 2 because it is based primarily on a comparison of the total annual inflow to the Delta under existing conditions and does not sufficiently take into account the seasonal changes in evapotranspiration demand. LADWP does not concur with the viewpoint that reduction in the outflow from the Delta would adversely affect habitat (except in the brine pool transition area as described in Section 6.3.5). It should also be noted that Impact Assessment No.2 concluded that, with implementation of the 50 cfs pump station and by adjusting the baseflows and pulse flows up to an average annual flow of 9 cfs under the proposed monitoring and adaptive management program (identified as Mitigation Measure D-1 in the Draft EIR/EIS but already included in the project description for LORP), impacts to the Delta wetland and aquatic habitats can be avoided. Therefore, for all intents and purposes, project impacts to the Delta wetland and aquatic habitats are less than significant under both Impact Assessment Nos. 1 and 2.

6.4 IMPACTS TO MINING OPERATION ADJACENT TO THE BRINE POOL

6.4.1 Background Information

The brine pool is located to the southwest of the Delta Habitat Area on the west central portion of Owens Lake, and encompasses about 25 square miles (16,000 acres). It consists of a body of crystalline salt deposits (trona ore) and lake bed sediments covered by a thin layer of concentrated brine. The thickness of the trona ore ranges from 1 to 9 feet, and the ore is saturated with concentrated brine. The brine level fluctuates from just below the surface to several inches above the surface, due to evaporation and runoff conditions.

There is an existing US Borax trona mining operation at the southern end of the lake adjacent to the brine pool. The trona is excavated from the surface deposits and stockpiled for dewatering before being trucked away. Mining is sensitive to fluctuations in the brine pool elevation. If the pool level rises, the mining operation must include construction of temporary berms composed of mined trona to prevent intrusion by the brine pool. A reduction in the brine pool would reduce brine concentrations in the mined material, making excavation and hauling easier.

As required by the court injunction regarding release of water to Owens Lake (No. 34042, amended September 29, 2000), LADWP will notify SLC staff and the lessee, at least annually, of planned releases of water onto or into Owens Lake for the purpose of implementing the LORP, and will implement reasonable measures to avoid damage to mining facilities on Owens Lake operated by the SLC lessee and/or to mineral deposits on Owens Lake.

6.4.2 Impacts

As shown in Table 6-9, the current estimated total annual discharge to the Delta from the Owens River is about 7,819 acre-feet (median annual flow). As described in Section 6.3.2.2, the average annual flows to the Delta and the lake under LORP would be about 5,498 to 5,997 acre-feet assuming annual average flows of 7.1 cfs released to the Delta. Hence, there could be an overall reduction in the amount of water passing through the Delta to the brine pool.

GBUAPCD provided an estimate of surface flows to the brine pool in the Final EIR for the Dust Mitigation Program (GBUAPCD, 1997). Surface flows to the lake are primarily derived from the Owens River, Sierra Nevada creeks, and periodic discharges from the Los Angeles Aqueduct. The total surface flow to the brine pool from these sources is estimated to be 40,000 to 50,000 acre-feet per year, which varies greatly from year to year based on runoff conditions. In addition to the surface flows, other sources that support the brine pool include direct recharge from precipitation on the playa and groundwater infiltration from adjacent alluvial deposits. Hence, the potential reduction in about 2,000 acre-feet per year under the proposed project would be minor compared to the overall water budget for the brine pool. The typical volume of the brine pool (with a surface area of about 16,000 acres) is about 40,000 acre-feet (Memorandum from Randy Jackson, 8-28-01).

The brine pool is very shallow, and as such, changes in volume will result in greater effects on the surface area. A change in 1,000 acre-feet of storage could increase or decrease the brine pool surface area by 2,200 to 2,700 acres (Memorandum from Randy Jackson, 8-28-01). Hence, the reduction in flows to the brine pool associated with the proposed flow regime to the Delta could measurably reduce the surface area of the brine pool. This impact may be offset in part, or wholly, by the groundwater infiltration due to rewatering of the river under the LORP and the water applied to the lake margins associated with the Dust Mitigation Program.

The reduction in flows to the brine pool could (1) reduce the size of the brine pool, or (2) have no effect on the size of the brine pool. Either condition would not adversely affect the existing trona mining operations in the brine pool. In fact, the reduction the flows to the brine pool may possibly result in a beneficial impact to the operations. Hence, the proposed flows to the Delta would not adversely affect the mining operations in Owens Lake.

6.5 IMPACTS - NOXIOUS PLANT SPECIES AND SALTCEDAR

The proposed flow release regime to the Delta could potentially increase the distribution and abundance of perennial pepperweed and other noxious plants, and stimulate the growth of saltcedar which is a non-native invasive plant that is spreading rapidly in the Owens Valley. The potential for the growth of saltcedar and other noxious plants is fully described in Section 10.4.

6.6 IMPACTS - MOSQUITOES

The LORP will result in new open water and marsh habitats at the Delta. These new habitats would provide more opportunities for mosquitoes to breed, which could result in increased nuisance and public health risks to communities and residents near these areas, and to the people engaged in outdoor recreation. The potential for the increase in mosquitoes is fully described in Section 10.3.