4.0 RIVERINE-RIPARIAN SYSTEM

4.1 MOU GOALS

Baseflows and Seasonal Habitat Flows

With regard to the riverine-riparian component of the LORP, the MOU provides that a continuous flow of 40 cfs will be maintained from the River Intake to a pump system located near the river delta at Owens Lake. The MOU provides that any water in the river that is above the amount required in the MOU for release to the Owens River Delta may be captured by the pump station. The specified flow regime in the MOU is as follows:

> (*i) A baseflow of approximately 40 cfs from at or near the Intake to the pumpback system to be maintained year-round.*
>
> *(ii) A seasonal habitat flow. It is currently estimated that in years when the runoff in the Owens River watershed is forecasted to be average or above average, the amount of planned seasonal habitat flows would be approximately 200 cfs, unless the Parties agree upon an alternative habitat flow, with higher unplanned flows when runoff exceeds the capacity of the Los Angeles Aqueduct. (The runoff forecast for each year would be DWP's runoff year forecast for the Owens River Basin, which is based upon the results of its annual April 1 snow survey of the watershed.) In years when runoff is forecasted to be less than average, the habitat flows would be reduced from 200 cfs to as low as 40 cfs in general proportion to the forecasted runoff in the watershed….*
>
> *(iii) A continuous flow in the river channel will be maintained to sustain fish during periods of temporary flow modifications."*

The baseflow of approximately 40 cfs from the River Intake to the pump station will be maintained year-round. Initially, the baseflow of 40 cfs will be verified by measurements at the temporary stream gages described in Section 2.3.5.2. Once the baseflow has been established, the 40-cfs baseflow will be verified at a minimum of four permanent stream gages located along the river, as specified in the MOU. The permanent gauging sites will be established before monitoring at the temporary monitoring sites is discontinued.

Annual seasonal habitat flows are intended to create a natural disturbance to establish and maintain native riparian vegetation and channel morphology. The MOU states the following purpose of the seasonal habitat flows (also called "riparian" flows):

> "To achieve and maintain riparian habitats in a healthy ecological condition, and establish a healthy warm water recreational fishery with habitat for native species, the plan would recommend habitat flows of sufficient frequency, duration and amount that would (1) minimize the amount of muck and other river bottom material that is transported out of the riverine-riparian system, but would cause this material to be redistributed on banks, floodplain and terraces within the riverine-riparian system and the Owens River delta for the benefit of the vegetation; (2) fulfill the wetting, seeding, and germination needs of riparian vegetation, particularly willow and cottonwood; (3) recharge the groundwater in the streambanks and the floodplain for the benefit of wetlands and the biotic community; (4) control tules and cattails to the extent possible; (5) enhance the fishery; (6) maintain water quality standards and objectives; and (7) enhance the river channel."

Habitat Indicator Species

The MOU states that: "*The goal for the Lower Owens River Riverine-Riparian System is to create and sustain healthy and diverse riparian and aquatic habitats, and a healthy warm water recreational fishery with healthy habitat for native fish species. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the 'habitat indicator species' for the riverine-riparian system.*" The habitat indicator species for the river are listed in Table 2-5. They include non-native game fish and a variety of native resident and migratory riparian and water birds and the Owens Valley vole.

In addition, the MOU includes the following goals that apply to the riverine-riparian component of the LORP:

1. LORP management should be consistent with applicable water quality laws, standards, and regulations.
2. Create and maintain healthy and diverse riverine, riparian, and wetland habitats through flow and land management, to the extent feasible, consistent with the needs of the "habitat indicator species" for the river. These habitats will be as self-sustaining as possible.
3. Create and sustain a healthy warmwater recreational fishery with healthy habitat suitable for native fish.
4. Comply with state and federal laws that protect Threatened and Endangered species.
5. Control deleterious species whose presence within the LORP area interferes with the achievement of the goals of the LORP. These control measures will be implemented jointly with other responsible agency programs.
6. Manage livestock grazing and recreational use consistent with the other goals of the LORP.

4.2 PROPOSED PROJECT

The proposed schedule for establishing the 40-cfs baseflow and release of seasonal habitat flows is described in detail in Section 2.3.5. The proposed 40-cfs baseflow will be established in two phases once LADWP has completed the channel clearing work, the modification of the River Intake structure, and installation of temporary flow measuring stations and several culverts. The first seasonal habitat flow will be released in the first winter following the completion of the pump station construction, and its peak flow will be 200 cfs regardless of the forecasted runoff. Subsequent seasonal habitat flows will be released in May or June, and the magnitude will depend on the forecasted runoff for the Owens Valley.

4.3 SURFACE WATER HYDROLOGY

4.3.1 Existing Conditions

The natural hydrology of the Owens River has been highly altered over the past 100 years due to various diversions. Initial diversion began in the late 1800s for agriculture when several hundred miles of canals were constructed to convey river water to adjacent farmlands. Irrigated agriculture peaked in the 1920s. In 1913, LADWP began diverting most of the river flow to the Los Angeles Aqueduct at the River Intake, which is located between Big Pine and Independence. LADWP uses Tinemaha Reservoir, which is upstream of the River Intake, to regulate flows into the Aqueduct and to store flows from the river during Aqueduct maintenance. Groundwater pumping began in the 1930s, and increased in the 1970s. Groundwater pumped above the River Intake is conveyed to the river prior to entering the Los Angeles Aqueduct; below the Intake, pumped groundwater is delivered to the Aqueduct.

Diversions at the River Intake

At the present time, flows in the river are diverted entirely to the Aqueduct at the River Intake. As a result, flows are absent in the river channel from the River Intake to about 5 Culverts northeast of Independence. Below the 5 Culverts area, flows in the river are primarily due to water released from the Aqueduct through spillgates and naturally occurring discharge from alluvial groundwater. The average annual quantity of water in the river between Tinemaha Reservoir and the River Intake is about 335,000 acre-feet.

Inflows to the Owens River Below the River Intake

The key inflows to the Lower Owens River under existing conditions include releases from spillgates along the Aqueduct for the Lower Owens River Rewatering Project as well as natural runoff. Initiated in 1986 by LADWP and Inyo County, the Lower Owens River Rewatering Project was one of 25 Enhancement/Mitigation Projects implemented between 1984 and 1990. Under the project, 18,000 acre-feet per year was to be released from the Blackrock spillgate to maintain a continuous flow in the Lower Owens River from the Blackrock area to the Owens River Delta. The objective of the project was to improve habitat for waterfowl, shorebirds, and fish in the river corridor and at the Delta. Water is released through various spillgates along the Aqueduct for recreational purposes to support the following lakes: Upper and Lower Twin Lakes, Goose Lake, Thibaut Ponds, and Billy Lake.

The initial releases under the Lower Owens River Rewatering Project were up to 18,000 acre-feet per year, or approximately 25 cfs on an annual basis. However, due to the drought of the late 1980s, significant water losses in the upper reach below the River Intake, and because of restrictions on groundwater pumping for the Rewatering Project under the Agreement, the releases were reduced to about 12,000 acre-feet per year and were initiated further south, beginning at the Independence spillgate. Since 1990, releases for the project have been maintained at about 12,000 acre-feet per year (equivalent to about 17 cfs). This project is still being implemented, but will be replaced by the LORP.

The spillgates include Blackrock, Independence, Locust, and Georges (see Table 4-1, Figure 2-1a-c). The Dean and Russell spillgates are used solely to maintain pastures and supply stockwater; flows from these spillgates (which are typically less than 1 cfs) do not reach the river. The Alabama spillgate is not used to maintain lakes or pasture. It is primarily used for sediment flushing and to discharge water when the Aqueduct must be maintained.

The median monthly flow rates from the key spillgates along the river from 1986-2001 are shown on Chart 4-1. This period of record was used because LADWP began releases from these spillgates in 1986 as part of the Lower Owens River Rewatering Project, described above. Peak releases of 5 to 12 cfs occur in June through September to support irrigated pasture as well as the current rewatering project. Winter releases are generally about 2 cfs or less. Blackrock spillgate generally exhibits the highest monthly flows.

The combined average annual discharge from the key spillgates from 1987 to 2001 has ranged from about 12,000 acre-feet to over 18,000 acre-feet, as shown on Chart 4-2. Spillgate discharges in 1986-87 were high due to high runoff from a very wet winter. The average annual discharges during 1986-2001 in all but the Blackrock spillgate are relatively constant from year to year.

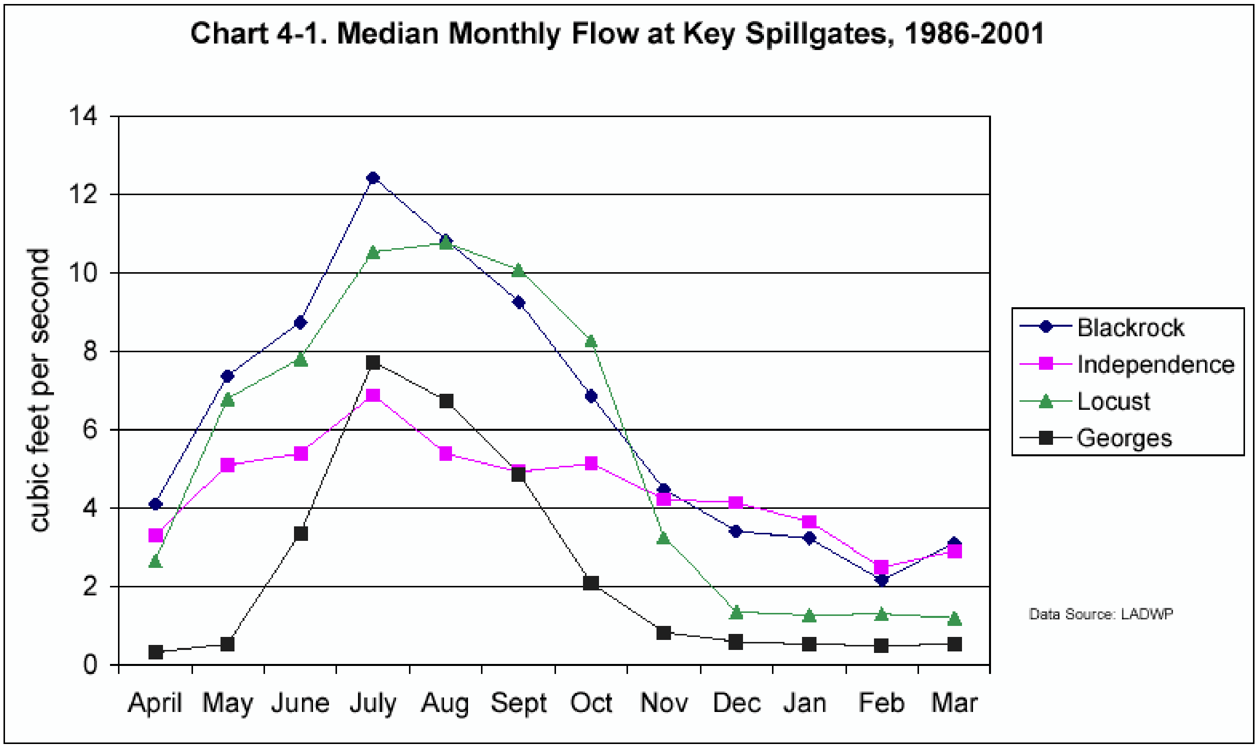


Chart 4-1. Median Monthly Flow at Key Spillgates, 1986-2001
cubic feet per second
0
2
4
6
8
10
12
14
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Blackrock
Independence
Locust
Georges
Data Source: LADWP

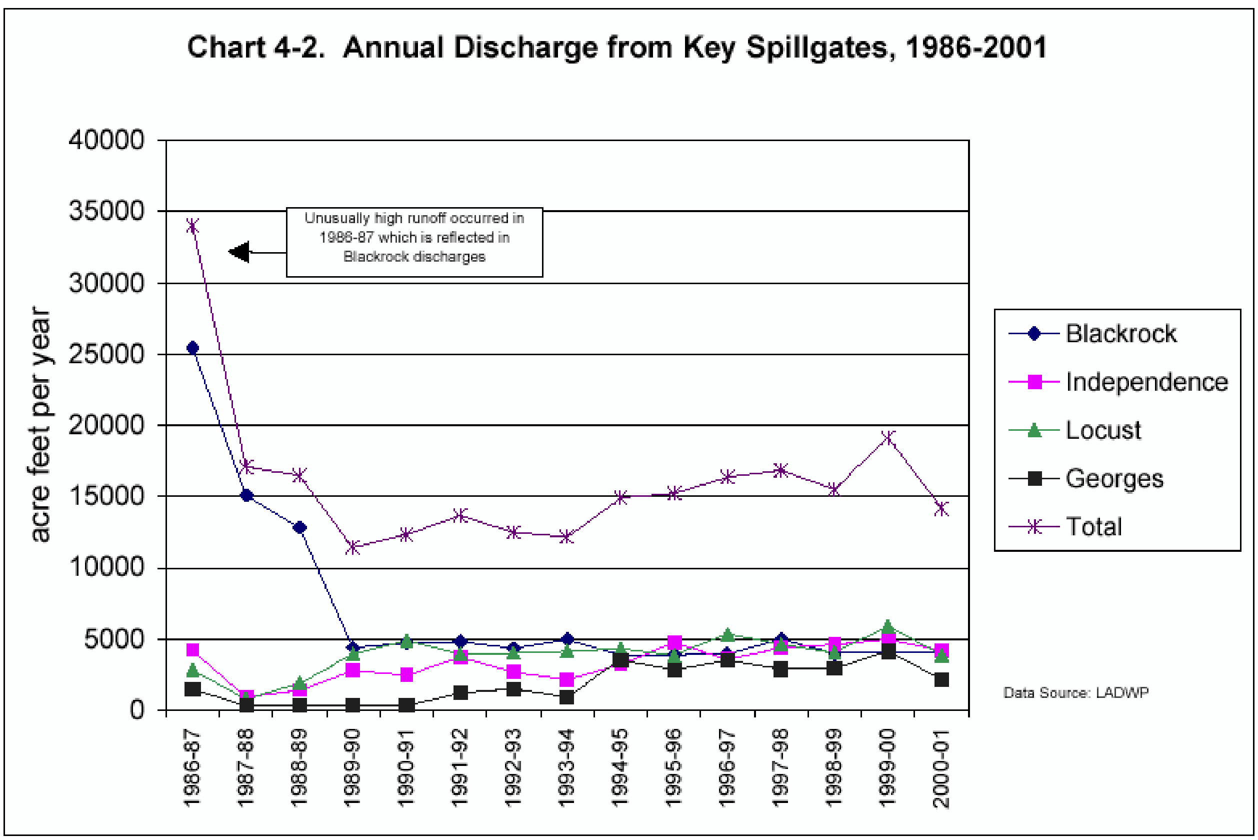


Chart 4-2. Annual Discharge from Key Spillgates, 1986-2001
acre feet per year
0
5000
10000
15000
20000
25000
30000
35000
40000
Unusually high runoff occurred in 1986-87 which is reflected in Blackrock discharges
1986-87
1987-88
1988-89
1989-90
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
Blackrock
Independence
Locust
Georges
Total
Data Source: LADWP

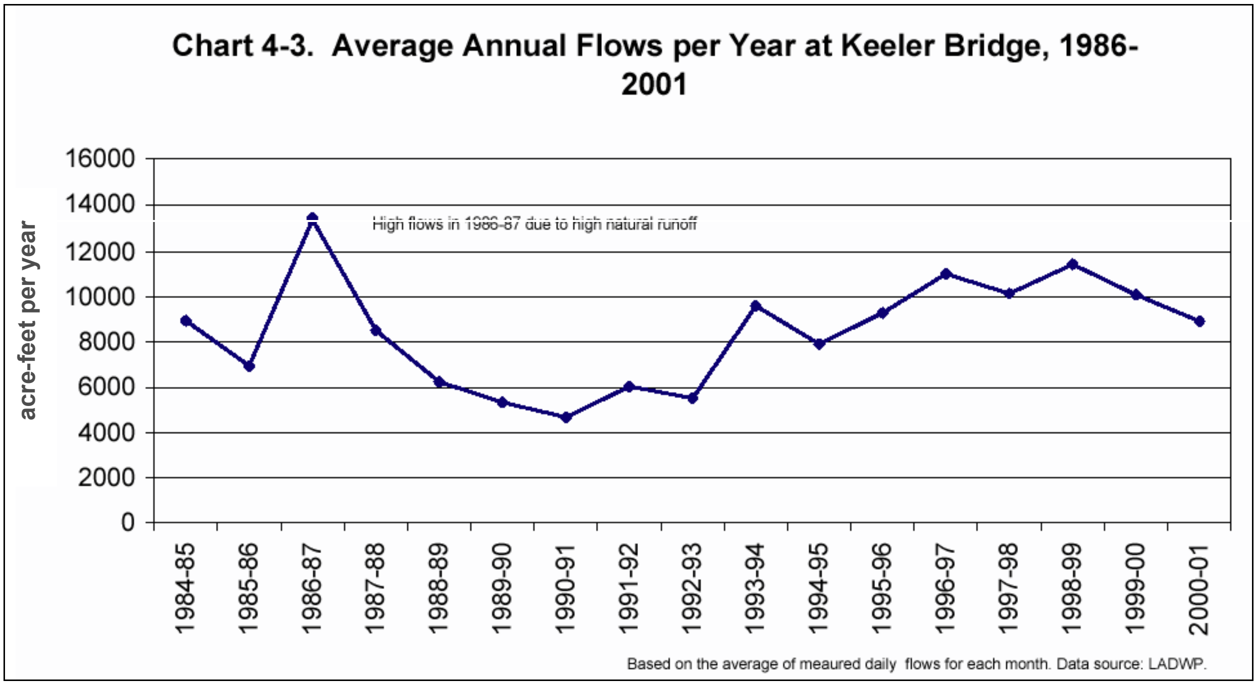


Chart 4-3. Average Annual Flows per Year at Keeler Bridge, 1986-2001
acre-feet per year
16000
14000
12000
10000
8000
6000
4000
2000
0
High flows in 1986-87 due to high natural runoff
1984-85
1985-86
1986-87
1987-88
1988-89
1989-90
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
Based on the average of meaured daily flows for each month. Data source: LADWP.

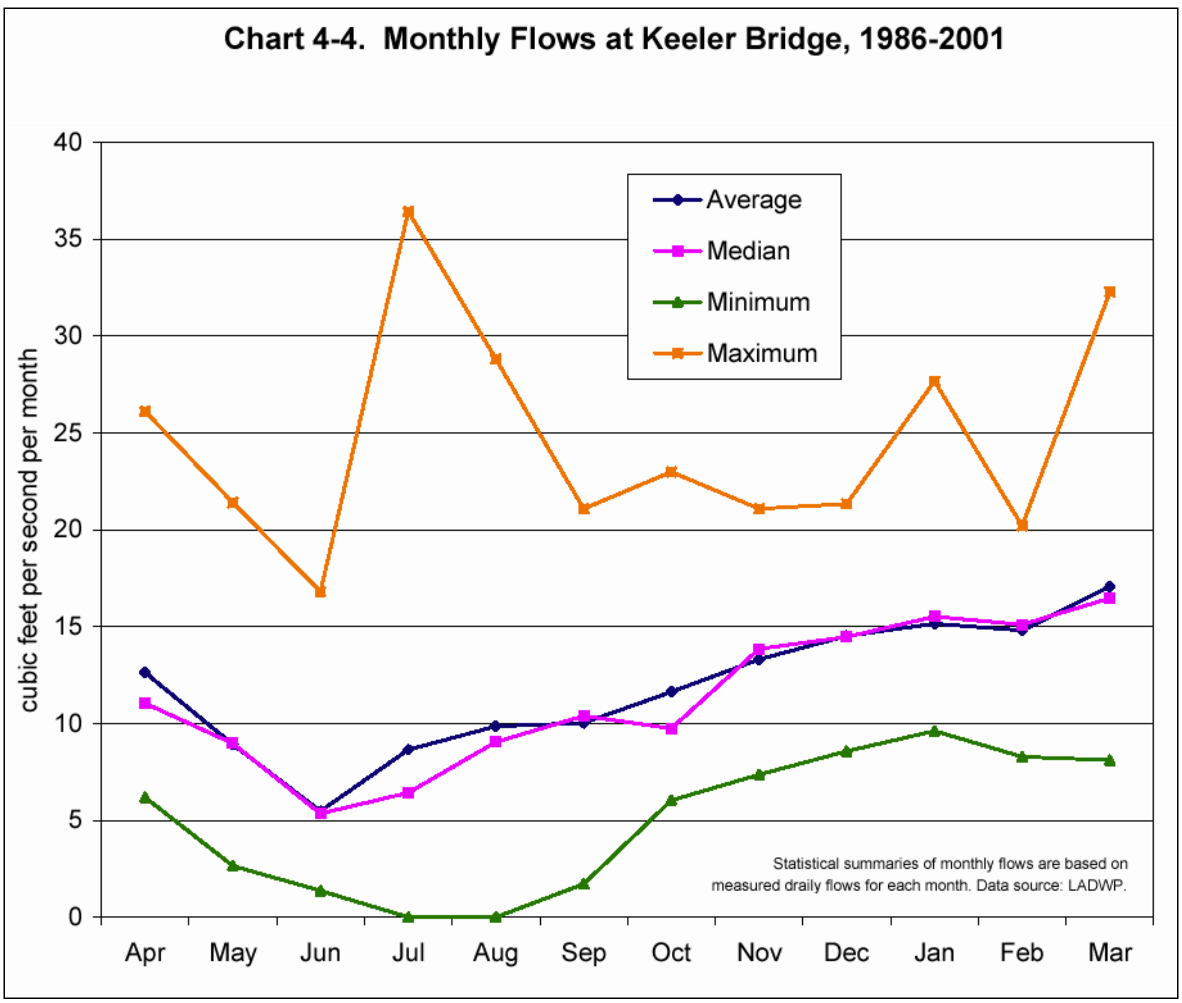


Chart 4-4. Monthly Flows at Keeler Bridge, 1986-2001
cubic feet per second per month
40
35
30
25
20
15
10
5
0
Average
Median
Minimum
Maximum
Statistical summaries of monthly flows are based on
measured draily flows for each month. Data source: LADWP.
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar

Measured Flows at Keeler Bridge

The only stream gage on the Lower Owens River is located near the Keeler Bridge. LADWP measures daily flows at the station, then compiles the records for average flows each month (herein called "average monthly flows") and for the entire year ("average annual flows"). Average annual discharge at Keeler Bridge for the period 1986-2001 is shown on Chart 4-3. Average monthly flows in the river from 1986 to 2001 ranged from about 5 to 17 cfs, as shown on Chart 4-4. The average annual flow over this time period was 11.8 cfs.

TABLE 4-1
SUMMARY OF KEY SPILLGATES CONTRIBUTING TO FLOW IN THE RIVER

Spillgate [see Figures 2-1a-e for locations]	Purposes of Releases	Current Release Regime (avg monthly flow unless otherwise noted)
Blackrock Spillgate	Water for livestock on Twin Lakes and Blackrock leases using Blackrock, Winterton, and Waggoner, maintain water in Twin Lakes and Goose Lakes; release excessive flows in the Aqueduct due to high inflows.	6.4 cfs (1986-2001 avg), year-round
Thibaut Spillgate	Irrigation for pastures on Thibaut Lease and to maintain Thibaut Ponds; water for livestock; spreading water in above average runoff years.	1 to 2 cfs (1986-2001 avg), year-round
Independence Spillgate	Water to maintain Billy Lake and to support fish and riparian habitat in the river; release excessive flows in the Aqueduct due to high inflows; Aqueduct maintenance; spreading water in above average runoff years.	4.7 cfs (1986-2001 avg), year-round
Locust Spillgate	Water for livestock on Blackrock lease in Locust Ditch and Steven's Ditch; release excessive flows in the Aqueduct due to high inflows ; Aqueduct maintenance; spreading water in above average runoff years.	5.4 cfs (1986-2001 avg) year-round
Georges Spillgate	Water for livestock on Blackrock lease in Steven's Ditch and Georges Ditch; irrigation for pasture; releases for fish and riparian habitat; release excessive flows in the Aqueduct due to high inflows; Aqueduct maintenance; spreading water in above average runoff years.	2.1 cfs (1986-2001 avg) year-round
Alabama Spillgate	Aqueduct maintenance; release excessive flows in the Aqueduct due to inflows from runoff; spreading water in above average runoff years.	Approximately 200 cfs for 2 hours, 4-6 times per year

Flows at Keeler Bridge are derived from releases from upstream spillgates that reach the river, runoff from precipitation and snow melt, and groundwater seepage. The latter consists of discharge from the shallow alluvial groundwater in the valley that becomes surface flow in the river between Mazourka Canyon Road and Keeler Bridge. An important source of recharge to the shallow groundwater is likely to be water released from spillgates. Hence, some water released from spillgates that does not reach the river probably still contributes to surface flow at Keeler Bridge due to groundwater discharge to the river.

Hutchinson (1986) estimated groundwater baseflows at Keeler Bridge prior to the Lower Owens River Rewatering Project (including recharge from spillgate releases) to be about 4 cfs in average years. Flows above this amount would be due to direct releases to the river from upstream spillgates and runoff from precipitation. Hence, it appears that of the approximately 12 cfs average flows at Keeler Bridge, about 4 cfs is attributed to groundwater baseflows and about 8 cfs is due to releases from spillgates (as surface water) and natural runoff. Irrigation and stockwater practices may contribute to groundwater baseflows.

The average monthly flows at Keeler Bridge in recent years (1986-2001) range from about 5 to 17 cfs, with the peak flows occurring in the winter and the minimum flows in the summer (Chart 4-4). On average, minimum and maximum flows range from as low as 5 cfs during the summer up to 17 cfs in winter. Daily flow measurements are made on a continuous recorder at the Keeler Bridge and are adjusted to account for obstructions in flow. This portion of the river supports numerous beaver, which build dams downstream of the bridge and cause elevated water levels at the bridge where the weir is located. When the weir is submerged, the hydrographer estimates the flow using a float stick. Hence, LADWP's estimates of discharge take into account the confounding effects of elevated water levels at the weir due to beaver dams.

River Channel Dimensions

The dimensions of the river channel within the project area vary considerably. The average width and depth of the primary channel are about 115 feet and 8.7 feet, respectively. However, certain reaches are much wider (up to 300 feet) or narrower (about 40 feet). The depth may reach 15 feet in certain locations. Above Mazourka Canyon Road, the channel has little vegetation. Below this point, where the river channel receives baseflows and runoff from spillgate releases, the channel is clogged with dense cattail and bulrush marsh, and contains intermittent small ponds created by beaver.

4.3.2 Potential Impacts – Surface Water Hydrology

The primary adverse hydrologic impact of concern associated with the release of flows to the river under the LORP is the potential for overbank flooding, bank erosion, channel degradation, or sediment deposition that could affect public infrastructure or private property. The potential for these impacts to occur is evaluated below based on hydraulic modeling and by observations during a 1993 field experiment in the river.

Hydraulic Modeling Analysis

Hydraulic modeling of the Lower Owens River was conducted by Don Chapman Consultants (1993) to predict water surface elevations, velocities, and new floodplains for various flows along the LORP project reach. The modeling was performed using the HEC-2 computer model designed by the Hydrologic Engineering Center of the USACE and based on 25 channel cross sections surveyed in the field. Modeling runs were conducted for the following discharges from the River Intake: 15, 30, 50, 80, 100, and 200 cfs. Modeling scenarios included current conditions with dense vegetation in the river channel and fine sediments on the bottom, and future conditions with no in-channel vegetation and a sandy bottom. The model was calibrated during the 1993 experimental re-watering of the river. The model did not estimate potential losses from the river due to evaporation, transpiration, and percolation.

Elevations of many cross sections were estimated from USGS topographic maps due to the lack of a consistent elevation datum along the project reach. Bridges and culverts along the project reach were not included in the analyses. As such, the results of the modeling are considered approximations for comparing between varying discharge levels, not precise predictions of future flow velocities, water surface elevations, or floodplain limits.

Two modeling scenarios were addressed. The first modeling run included the entire 62-mile long project reach and assumed that the existing high level of in-channel vegetation would remain. The second modeling analysis was performed for a shorter reach of the river and included two channel conditions: current dense in-channel vegetation and open channel with little vegetation. The latter condition is anticipated to occur after several years of high seasonal habitat flows.

In addition to the above modeling, Don Chapman Consultants (1993) also conducted sediment transport modeling of the LORP reach using the HEC-6 model (also designed by the USACE) to estimate the extent of channel bed elevation changes due to the seasonal habitat flows.

HEC-2 model predictions for average flow velocities under existing and future conditions are presented in Table 4-2. As reflected in the modeling results, the low overall gradient of the river and the presence of dense in-channel vegetation impede flows. Average water depth is predicted to increase about 1.5 feet under the new baseflows, and about 4 feet with the seasonal habitat flows. The average width of the wetted channel is predicted to increase by 30 feet under the new baseflows, and nearly double to about 85 feet under the maximum seasonal habitat flows of 200 cfs.

TABLE 4-2
SUMMARY OF WATER SURFACE ELEVATION MODELING

Average Values	**Simulated Flows Under Current Conditions (Estimated at 2-5 cfs)**	**Simulated Baseflows under Future Conditions (50 cfs)***		**Simulated Seasonal Habitat Flows under Future Conditions (200 cfs maximum release)****	
		New Value	**Percent Increase**	**New Value**	**Percent Increase**
Velocities (feet per second)	0.33	0.55	67percent	0.98	197 percent
Water Depth (feet)	3.08	4.50	46 percent	7.32	138 percent
Flow Width (feet)	47	75	60 percent	85	81 percent

Source: Don Chapman Consultants, 1993. Assumed no change in current in-channel vegetation conditions and no channel losses. A 62-mile long reach was modeled. The model does not account for evapotranspiration or percolation.
* 50 cfs was used in the study, before a 40-cfs baseflow was selected. Hence, values for the 50-cfs flows are approximations for a 40-cfs baseflow condition.
**Seasonal habitat flows will be released at the Intake and will be reduced over the modeled flow due to evaporation, transpiration and percolation.

It is important to note, however, that the modeling was performed for a range of flows between 10 cfs and 200 cfs before the 40-cfs baseflow and 200-cfs seasonal habitat flows were selected. The model results shown below are considered to be the most representative of a 40-cfs baseflow. However, these results are likely to be higher than actual conditions, because the project baseflow will be less than what was modeled, the maximum seasonal habitat flows will not be achieved throughout the river, and the model does not account for evaporation, transpiration, and percolation.

Seasonal habitat flows may or may not remove cattail and bulrush marsh vegetation from the river channel over time (see below). In the event that channel vegetation (and therefore, channel roughness) is reduced, there would be substantial increases in velocities associated with the baseflows and seasonal habitat flows, as shown in Table 4-3. Flow velocities could exceed 1 (foot per second) fps for baseflows once the channel has been cleared of marsh vegetation, more than five times greater than with the in-channel vegetation (which exists in the currently wetted reach). Flow velocities with a cleared channel during the seasonal habitat flows would increase to almost 3 fps. Water depth and width of the wetted channel would not increase as much with a cleared channel because there would be less “backwater” effect due to high channel roughness.

TABLE 4-3
EFFECT OF IN-CHANNEL VEGETATION ON HYDRAULICS

Average Values	Simulated Flows Under Current Conditions (Estimated at 2-5 cfs)	Simulated Baseflows under Future Conditions (50 cfs)*		Simulated Seasonal Habitat Flows under Future Conditions (200 cfs maximum release)**	
		New Value	Percent Increase	New Value	Percent Increase
Hydraulic Conditions with Dense In-Channel Vegetation					
Velocities (feet per second)	0.27	0.38	41 percent	0.69	156 percent
Water Depth (feet)	2.37	4.02	70 percent	7.45	214 percent
Flow Width (feet)	63	87	38 percent	142	125 percent
Hydraulic Conditions without Dense In-Channel Vegetation					
Velocities (feet per second)	1.21	1.68	38 percent	2.66	119 percent
Water Depth (feet)	2.26	2.75	3 percent	3.77	66 percent
Flow Width (feet)	52	64	23 percent	82	58 percent

Source: Don Chapman Consultants, 1993. The values for existing conditions vary slightly from Table 4-2 because the above analysis only used a small portion of the river, while the data from Table 4-2 are based on modeling the entire river.
* 50 cfs was used in the study, before a 40-cfs baseflow was selected. Hence, values for the 50-cfs flows are approximations for a 40-cfs baseflow condition.
** Seasonal habitat flows will be released at the Intake and will be reduced over the modeled flow due to evaporation, transpiration and percolation.

The effects of baseflows and seasonal habitat flows on channel bed elevations are shown in Table 4-4. As anticipated, the predicted velocities with dense, in-channel vegetation are too low to cause substantial scouring. Overall, the baseflows are predicted to lower the channel bed by a very small amount (0.24 feet, on average). The modeling showed that minor scouring may also occur at the lowest discharge modeled, 15 cfs. The depth of scouring may double if the channel is cleared of vegetation, but will remain low (averaging 0.45 feet). The 200-cfs seasonal habitat flows are predicted to cause greater overall channel degradation, particularly if in-stream vegetation has been removed. Areas of substantial channel degradation may occur under the seasonal habitat flow (e.g., up to 5 to 10 feet); however, these areas of maximum degradation are expected to be localized.

TABLE 4-4
PREDICTED CHANNEL BED ELEVATION CHANGES

Channel Bed Changes (feet)	Future Conditions with Dense In-Channel Vegetation		Future Conditions without In-Channel Vegetation	
	Baseflows (~30 cfs)	Seasonal Habitat Flows (200 cfs)	Baseflows (~30 cfs)	Seasonal Habitat Flows (200 cfs)
Average Channel Bed Change	-0.24	-0.70	-0.45	-1.54
Maximum Channel Bed Scour	-1.91	-5.00	-4.12	-9.90
Maximum Channel Bed Deposition	+0.24	+0.60	+0.29	+0.63

Source: Don Chapman Consultants, 1993.

Flow Velocities Observed in 1993 Field Experiment

In July-August 1993, Ecosystem Sciences conducted an experimental study to calibrate flow and habitat models to identify desired flows for the river channel. Ecosystem Sciences used these data to develop recommendations for a baseflow and seasonal habitat flows to the river. Over a period of 38 days, water was released into the river channel at the Intake. The initial discharge from the River Intake was approximately 20 cfs and was rapidly increased to 155 cfs. Flow measurements were collected at various downstream sites during the study. Average flow velocities during 39-cfs and 91-cfs flows at a measuring station located just south of Mazourka Canyon Road are shown in Table 4-5. Based on the relationship observed between discharge and velocities, Inyo County staff estimated that average flow velocity at the Mazourka Canyon Road station would be about 2.4 fps with a 200-cfs discharge in the river at that location (Randy Jackson, pers. comm.).

TABLE 4-5
OBSERVED FLOW VELOCITIES AT MAZOURKA CANYON ROAD DURING 1993 FIELD EXPERIMENT

Discharge (cfs)	Measured Flow Velocity (feet per second)
39	1.29
91	1.62

The observed flow velocities at Mazourka Canyon Road were similar to average values estimated by the hydraulic modeling shown in Table 4-3 for a channel without dense vegetation. The channel at the Mazourka Canyon Road station was relatively free of in-channel vegetation.

Effect of Flow Velocities on Tules and Beaver Dams

The magnitude of seasonal habitat flows was not defined with the specific objective of creating velocities high enough to scour tules and/or dislodge beaver dams. Tule suppression will primarily be a result of increased inundation and shading (from growth of riparian trees) along with an increase in flow velocity. Beaver dam control will primarily be mechanical (see Section 2.3.7).

Ecosystem Sciences Technical Memorandum #9 cites a study on hydrodynamic control of emergent aquatic plants (cattails and bulrushes, called "tules" here) in the Owens River Valley – by Groeneveld (1994). The memorandum reproduces from that study a mathematical relation between depth, velocity, and tule stem diameter, which attempts to predict whether certain flows would dislodge tules.

Substituting values of 1 meter for depth and 0.025 meters (one inch) for stem diameter yields a velocity of 0.32 meters per second, or approximately 1 fps to remove tules. Results of the HEC-2 modeling by Don Chapman Consultants (1993) indicate that average velocities for both the 40-cfs baseflows and the 200-cfs seasonal habitat flows in a channel with dense vegetation would not exceed this value. However, observations of flow velocities at the Mazourka Canyon Road station during the 1993 field experiment were greater than 1 fps under both baseflow conditions, and when the discharge from the River Intake was 155 cfs (Jackson, 1994a). Hence, there is potential for some localized scouring of tules with the proposed flow regime, based on the available data.

There are no available data to analyze the flows necessary to remove beaver dams. Jackson (1994a) reported that the experimental flows of 1993 removed one dam. The maximum discharge during the experimental period was 155 cfs. Therefore, higher flows of longer duration during the proposed seasonal habitat flows could remove or breach some beaver dams along the river, which would lower water surface elevations behind them.

Summary of Hydraulic Impacts

The hydraulic modeling and observations of flows during the 1993 field experiment suggest the following effects of baseflows and seasonal habitat flows:

- Once dense in-channel vegetation is removed, the increase in water depth and width of the wetted channel would be modest under the baseflows, which would be contained within the current active channel. Most of the seasonal habitat flows would also be contained within the active channel, except in localized reaches where the flows may break out of the channel due to low banks or obstructive vegetation.
- The predicted and observed velocities under the baseflows and seasonal habitat flows are not likely to cause bank erosion. However, the velocities may be sufficient to remove limited amounts of cattails and bulrushes in localized areas.
- If cattail and bulrush marsh vegetation is removed from the channel, flow velocities and channel bed scouring will increase. However, the predicted velocities are still relatively low and not considered erosive.
- Predicted velocities under the seasonal habitat flows appear to be sufficient to remove some beaver dams, or breach the dams, but not high enough to remove all dams.

Based on the modeling analysis, the proposed new flows in the Lower Owens River are not expected to cause significant bank erosion, channel degradation, or sediment deposition. However, there is potential for localized overbank flooding that could affect several public roads and lease roads that cross the river (e.g., Mazourka Canyon Road, Manzanar-Reward Road, and Keeler Bridge). This impact could occur if floating debris clogs the culverts and bridges at these crossings, primarily under the seasonal habitat flows. If flow under these roads is obstructed, overbank flooding could affect the roads. **This impact is considered potentially significant, but mitigable (Class II).** Flooding can be mitigated by monitoring these crossings during seasonal habitat flows and removing debris as necessary (see Mitigation Measure H-1 below).

Upstream Hydraulic Impacts

The water levels and release regime in Tinemaha Reservoir upstream of the River Intake would not be modified to achieve the releases from the River Intake. Water is released from this regulating reservoir to the river, where it is conveyed to the Aqueduct Intake. Water surface elevations in the river upstream of the intake typically vary up to 5 feet over the course of a month. Under the proposed project, 40 cfs would be continuously released to the river at the same time that water is diverted into the Aqueduct Intake for export. This combined operation is not expected to change the range of water surface elevations in the river upstream of the two intakes, nor in Tinemaha Reservoir (B. Tillemans, LADWP, pers. comm.). Similarly, releases of up to 200 cfs for short-term seasonal habitat flows each year are also not expected to lower the river upstream of the Intake below its typical operational range.

Sediment is currently removed on a periodic basis from the river upstream of the Aqueduct and River Intake structures in order to maintain a suitable channel invert elevation for these gates. The diversion of water to the river under the LORP would not affect the frequency or magnitude of this ongoing operation.

4.3.3 Mitigation Measures

H-1 During seasonal habitat flows, Inyo County shall monitor culverts and bridges on County roads along the river and LADWP shall monitor culverts on other roads to determine the potential for debris plugs to form at road crossings. Obstructive debris will be removed as necessary to minimize flooding the roads.

4.4 WATER QUALITY

4.4.1 Background

The Lower Owens River Project will establish permanent flows in the river channel that differ from the existing conditions. Previous experiments to manipulate flows in the river suggest that degraded water quality could be significant during the initial years of project implementation. This section describes the regulatory framework relative to water quality in which the project will be implemented, the existing conditions as measured during a series of data collection efforts, and the potential effects to water quality that could occur in response to the introduction of higher flows in the river.

Regulatory Framework and Beneficial Uses

The primary responsibility for the protection of water quality in California resides with the State Water Resources Control Board (State Board) and its nine Regional Water Quality Control Boards. The State Board sets statewide policy for the implementation of state and federal laws and regulations. The Regional Boards adopt and implement Water Quality Control Plans (Basin Plans).

The LORP occurs in the jurisdiction of the Lahontan Regional Water Quality Control Board (Regional Board). The Basin Plan for the region sets forth water quality standards for surface and ground waters of the region, which include: (1) designated beneficial uses of water; and (2) narrative and quantitative water quality objectives. The Regional Board seeks to maintain the water quality objectives through its planning and permitting authorities to protect designated beneficial uses. The Lower Owens River below the River Intake has been classified in the Basin Plan as an "ephemeral stream." Other waterbody classifications applicable to the Lower Owens River include perennial stream, wetlands, lakes, seeps/springs, wet meadow, and floodplain. Designated beneficial uses for the Lower Owens River from the Basin Plan are as follows:

- Agricultural Supply
- Cold Freshwater Habitat
- Preservation of Biological Habitats of Special Significance
- Commercial and Sportfishing
- Freshwater Replenishment

- Groundwater Recharge
- Municipal and Domestic Water Supply
- Warm Freshwater Habitat
- Spawning, Reproduction, and Development
- Rare, Threatened, and Endangered
- Water Contact Recreation
- Non-Contact Water Recreation
- Wildlife Habitat

The water quality objectives that apply to the Lower Owens River are listed in Table 4-6. They are primarily narrative objectives.

TABLE 4-6
WATER QUALITY OBJECTIVES THAT APPLY TO THE LOWER OWENS RIVER

Parameter or Constituent	Water Quality Objective
Ammonia	Varies depending on temperature and pH
Coliform bacteria	Log mean 20 count/100 ml over 30-day period, no more than 10 percent of 30-day samples shall exceed 40 count/100 ml
Biostimulatory substances	Concentrations shall not promote aquatic growth that is a nuisance or adversely affect beneficial uses
Chemical constituents	Title 22 Maximum Contaminant Level (MCL)
Chlorine	Median 0.002 mg/l (daily values over 6-month period) or maximum of 0.003 mg/l
Dissolved oxygen	Shall not be depressed more than 10 percent, nor reduced to less than 80 percent saturation. Specific limits for COLD and WARM water designations over 7- and 1-day periods are described in Basin Plan.
Floating materials	Amounts must not cause nuisance or adversely affect beneficial uses
Oil and grease	Amounts must not create film, cause nuisance, or adversely affect beneficial uses
Non-degradation of aquatic communities and populations	Must not create undesirable or nuisance aquatic life, or that cause adverse effects on plants and animal. Wetlands must be protected from impairments.
Pesticides	Amounts must not exceed lowest detectable limits, and not bioaccumulate in sediments or aquatic life
pH	Changes in normal range must not exceed 0.5 units (COLD and WARM)
Radioactivity	Amounts must not be present in deleterious concentrations
Sediment	Amounts shall not cause nuisance or adversely affect beneficial uses
Settleable materials	Amounts shall not cause nuisance or adversely affect beneficial uses
Suspended materials	Amounts shall not cause nuisance or adversely affect beneficial uses
Taste and odor	Amounts shall not be in concentrations that cause undesirable taste and odors
Temperature	Receiving water temperature shall not altered such that beneficial uses are adversely affected
Toxicity	Waters must be free of toxic substances
Turbidity	Amounts shall not cause nuisance or adversely affect beneficial uses. Increases shall not exceed natural levels by more than 10 percent

Source: Regional Board, 1994.

The State Board has adopted a Nondegradation Objective based on Resolution 68-16. Under this objective, whenever the existing water quality is better than that needed to protect all existing and probable future beneficial uses, the existing high quality shall be maintained until or unless it has been demonstrated to the State that any change in water quality would be consistent with the maximum benefit of the people of the State, and would not unreasonably affect present and probable future beneficial uses of such water.

In a letter to LADWP dated May 19, 1998, the Regional Board staff indicated the following positions relative to the current waterbody classification and designations of beneficial uses:

- After implementation of the rewatering of the lower river under the LORP, the Regional Board would consider a potential modification of the waterbody classification as an ephemeral stream.
- The designation of the Municipal and Domestic Supply beneficial use would remain unchanged with the LORP because there is potential for municipal water use in the future as river water quality improves with time, and because water from the river would be reintroduced to the Aqueduct by the pump station.
- Upon implementation of the LORP, the Regional Board would ask the California Department of Fish and Game if the current designation of Cold Freshwater Habitat for fish is appropriate, in light of the LORP objectives of enhancing the warmwater fishery of the river.
- Following completion of the LORP, the Regional Board may consider adjusting the narrative DO objective

Impaired Waters and TMDL

Section 303(d) of the federal Clean Water Act requires states to identify surface water bodies which are not attaining water quality standards and are not expected to do so even with the use of technology-based effluent limitations and other legally required pollution controls such as Best Management Practices. Waters may be listed for more than one pollutant. For each listed water body/pollutant combination, states must develop a Total Maximum Daily Load, or TMDL, to ensure attainment of standards. The most recent Section 303(d) list, including priority ranking for TMDL development, was completed in 2002 and approved by USEPA in July 2003.

The Owens River (including reaches within the LORP area) is included in the current 303(d) list with "habitat alteration" as the pollutant/stressor (Regional Board, 2003). The potential sources of this impairment are listed as agriculture and hydromodification. Arsenic was included in the previous 303(d) list (Regional Board, 1999), but was excluded from the current list. Arsenic in the Owens River comes from natural (volcanic and geothermal) sources. The Owens Lake was included in the previous 303(d) list for salinity, total dissolved solids, and chlorides, but was excluded from the current 303(d) list. The salts and trace elements present in its brine at Owens Lake come from natural sources.

Under the current 303(d) list, the priority for TMDL development for Owens River and Owens Lake is listed as low, with a note indicating that the river may be placed on a separate list not needing TMDLs due to pending changes in federal regulations (Regional Board, 2003). The schedule for completion of TMDLs has not been established.

4.4.2 Existing Conditions

Water Quality Data Sources

Water quality in the Lower Owens River was examined by several studies and monitoring efforts conducted by LADWP and the Inyo County Water Department. The following reports and data were used as the basis for the evaluation of existing and potential future water quality conditions described in this section.

1. *Lower Owens River Planning Study: Transient Water Quality in the Lower Owens River during the Planning Study Flow Releases in July and August of 1993* (Jackson, 1994a). Water quality parameters in grab samples were measured on an almost daily basis during the 38-day long 1993 flow study at nine sites along the river. Five water quality parameters were measured: dissolved oxygen (DO), turbidity, pH, electrical conductivity and temperature.

2. *LADWP Water Quality Data from 1993 Field Experiment.* LADWP personnel collected water samples for hydrogen sulfide, ammonia, and other constituents on August 5, 1993, while flows were being decreased in the river.

3. *Lower Owens River Planning Study: Water Quality in the Lower Owens River Enhancement/ Mitigation Project, May 1995 through June 199*6 (Jackson, 1996). In this study, water quality measurements were collected from six river sites near and upstream of Keeler Bridge and at three spillgates. Measurements were collected weekly during most of 1995, then biweekly during 1996. At each site, grab samples were analyzed for dissolved oxygen, turbidity, pH, electrical conductivity and temperature. A total of 1,312 measurements were made.

4. *Lower Owens River Planning Study: Water Quality in Selected Off-River Lakes and One On-River Pond in the Lower Owens River Enhancement/Mitigation Project, July 1996 through June 1997* (Jackson, 1997). In addition to providing water quality data for the off-river lakes and ponds within the project area, this report includes river water quality data from Lone Pine Pond.

5. *1999 Comprehensive Water Quality Sampling (Jackson, 1999, unpublished data).* In 1999, Inyo County continued its water quality sampling with a more comprehensive analysis of water quality parameters in the river. Samples were collected from eight locations along the river and at Goose Lake. The samples were analyzed for 123 constituents and water quality parameters, including various minerals, compounds, physical properties, and organic compounds. Basic water quality parameters were measured in the field. Samples were collected and measurements were made in March 1999 and August 1999.

Characterization of Existing Water Quality

The primary conclusions about existing water quality in the river under pre-project management practices based on the above referenced water quality studies are summarized below. Results of the 1995-96 water quality sampling by Inyo County are presented in Table 4-7.

- Water quality in the Aqueduct was good, as shown by measurements by Jackson (1994a) during the 1993 field experiment. DO concentrations were moderately high (mean = 6.4 mg/l, range of 4.2 to 7.2 mg/l). DO concentrations above 5 mg/l are desirable for the protection of aquatic life. Temperatures ranged from 67 to 75 degrees F, and pH values ranged from 7.2 to 8.5. Dissolved solids were low as measured by electroconductivity (range of 0.22 to 0.33 milliohms/cm, or estimated 140 to 211 mg/l total dissolved solids by Jackson [1994a] using the equations of Bohn [1985]).

- DO levels were about 7.5 to 8.5 mg/l in water released to the river from the various spillgates along the Aqueduct.

- In general, DO levels in the Lower Owens River decrease with distance downstream from the River Intake. In 1995-96, DO levels, which were measured in the wet reach of the river, decreased to below

5 mg/l at all of the monitoring sites at some time during the year, but were above 2 mg/l most of the time. Concentrations below 1 mg/l are generally lethal to fish. The DO water quality objective from the Regional Board's Basin Plan that applies to the river consists of three elements: 6.5 mg/l for 30-day mean, 5 mg/l for a 7-day mean, and 4.0 mg/l for a 1-day mean. Based on individual measurements, the DO levels in the river do not meet these objectives on a regular basis.

- Turbidity is caused by suspended matter such as clays and organic matter, soluble colored organic compounds, and algae. In general, turbidity levels decreased from Mazourka Canyon Road to the pump station site. Over the course of a year, turbidity levels were higher in the spring and lower in the summer and fall. High turbidity levels were present in the Aqueduct and in the Owens River upstream of the River Intake, due in part to the higher flows that keep material suspended. High turbidity levels also occurred in water released from the spillgates, reflecting the high turbidity levels in the Aqueduct. Turbidity levels were lower in the river below the River Intake due to low flow velocities, which allow suspended material to settle.

- The pH of the river in 1995-96 was about 8, which is typical of natural waters and suitable for aquatic life. The pH in the Aqueduct was slightly higher than in the river.

- Electrical conductivity is related to the concentration of dissolved solids, and can be used to estimate total dissolved solids (TDS). The TDS levels in the river upstream of the River Intake and in the Aqueduct were less than 200 mg/l. TDS concentrations increased with distance along the river. TDS is higher in the winter. TDS levels drop in the summer.

- Mean water temperatures in 1995-96 remained nearly constant with distance downstream or decreased slightly along the river.

TABLE 4-7
SUMMARY OF WATER QUALITY DATA FROM THE LOWER OWENS RIVER AND KEY SPILLGATES, 1995-96

Sampling Location	Mean Value During 1995-96 Study (No. of samples: 10-46 per location)									
	Dissolved Oxygen (mg/l)			Tur-bidity (NTU)	pH	Elec. Cond. (*m*ohms/cm)	Total Dissolved Solids (mg/l)	Temperature (F)		
	Max	Min	Avg					Max	Min	Avg
Mazourka Cyn Rd	10.2	4.5	7.3	3.2	8.2	0.28	178	72	36	57
Reinhackle Springs	8.5	2.5	5.5	2.7	7.9	0.33	212	72	36	60
Lone Pine Ponds	6.2	1.2	3.9	2.3	7.9	0.61	392	72	36	57
Lone Pine Station	6.2	0.5	3.6	2.9	7.9	0.63	401	74	37	57
Keeler Bridge	7.2	1.6	4.4	3.1	8.1	0.66	421	73	37	58
Pump Station	7.5	1.5	5.1	2.0	8.4	0.94	603	70	34	50
Independence Spillgate	9.8	6.0	7.6	12.2	8.5	0.20	125	73	46	63
Locust Spillgate	9.0	5.7	7.8	14.9	8.4	0.20	129	71	40	60
Georges Spillgate	9.5	7.4	8.6	12.8	8.4	0.19	119	69	42	58

Source: Jackson, 1996, Inyo County Water Department. Interested reader is directed to that report for more information.

Key water quality results from the 1999 field sampling (Inyo County, unpublished data; Item 5 above) are shown on Chart 4-5 and summarized below. The sampling dates in the winter and summer of 1999 were February 23, 1999 and August 2, 1999, respectively.

- Dissolved oxygen levels were higher in the winter, as noted in 1995-96. Summer levels were below 4 mg/l, which is below the Basin Plan water quality objective.

- Turbidity was low in the river, except at the Independence spillgate, confirming that water from the Aqueduct has high turbidity, which declines after diversion to the river.

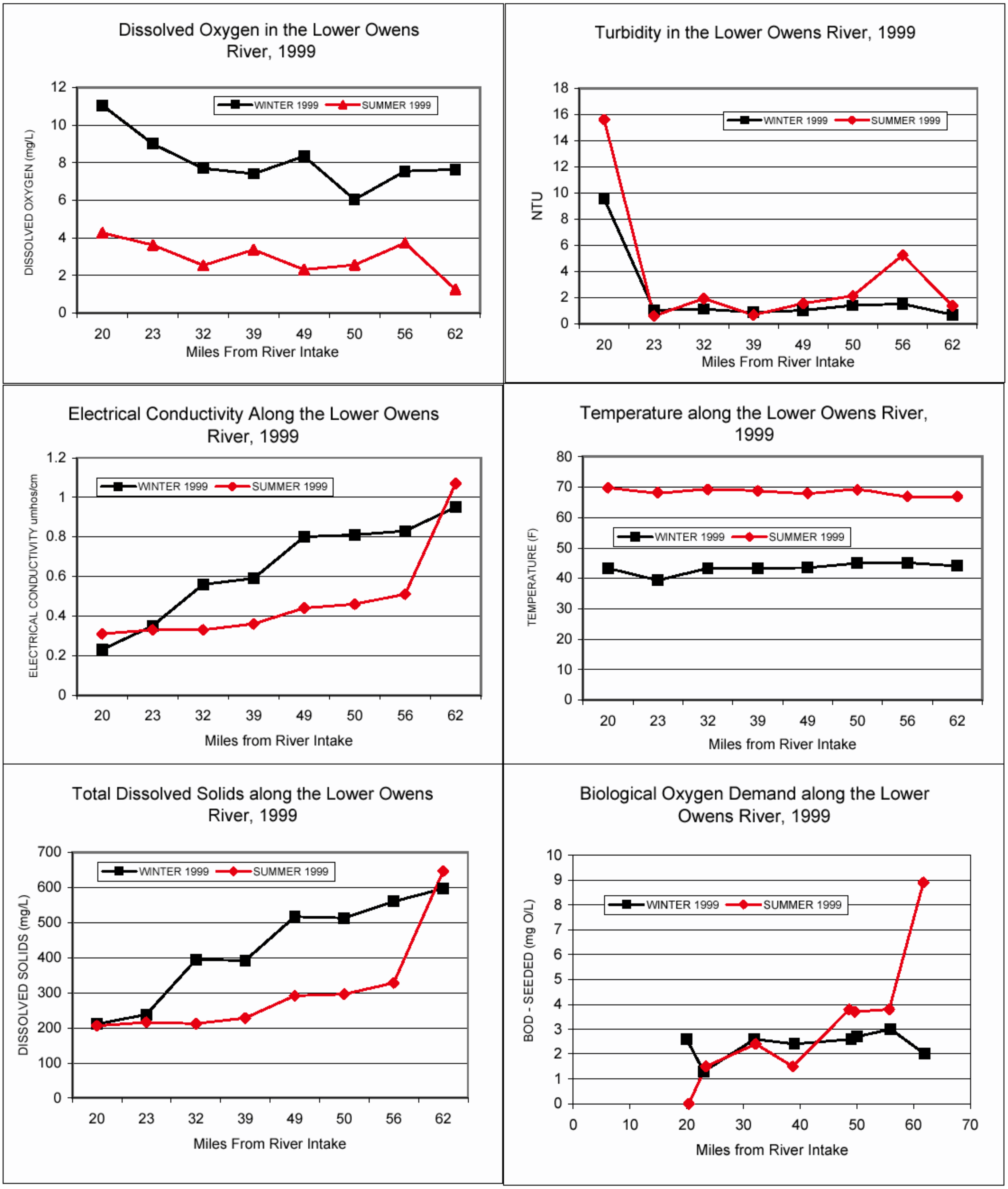
- Electrical conductivity and total dissolved solids increased along the river, consistent with the 1995-96 results.

- Temperature was constant along the river, but there was a significant difference between summer and winter temperatures. Water temperatures were most suitable for warmwater fish, with summer temperatures of 68 degrees F in the summer and 41 degrees F in the winter

- Biochemical oxygen demand (BOD) is a measure of the amount of biodegradable organic matter in waters that is available for microbial decomposition, a process which depletes oxygen. Hence, a high BOD signifies conditions in which DO levels would decrease due to the presence of organic compounds such as animal waste or plant detritus. BOD_5 levels in 1999 were generally low and consistent along the entire river, and showed little difference between the summer and winter except at two sampling sites. BOD ranged from 1 to 9 mg/l in the wet reach of the river.

In summary, the water quality data for the Lower Owens River indicate that existing DO levels fluctuate greatly (1 to 11 mg/l) and are often below Basin Plan water quality objective levels and near deleterious levels for aquatic life. DO levels generally decrease in the summer and with distance along the river. TDS are relatively high compared to natural runoff and water in the Aqueduct. TDS concentrations increase along the river. Temperatures vary greatly between seasons, and are suitable for warmwater fish. Turbidity levels are low compared to the Aqueduct. These conditions are typical of warmwater streams. In the past, the Regional Board has characterized warmwater fisheries habitat (designated as "WARM") as being less sensitive to environmental changes than cold freshwater fish habitat, and with greater fluctuations in temperature, dissolved oxygen, pH, and turbidity.

The comprehensive sampling in 1999 by Inyo County included a large number of minerals, chemical pollutants, and organic compounds. Elevated levels of the following parameters were observed: manganese, chloride (winter only), fluoride, and orthophosphates. The results did not indicate water quality problems related to coliform bacteria, pesticides, ammonia, total nitrogen, sulfates, and various organic compounds. No exceedances of quantitative Basin Plan water quality objectives were found, with the exception of DO.



Data Source: Inyo County

Chart 4-5. Water Quality Along the Lower Owens River, 1999

Channel Organic Sediments or Muck

The river channel in the wetted portion of the river from near Mazourka Canyon Road to the pump station site contains significant deposits of organic sediments or muck. These anaerobic deposits are comprised of plant detritus, cattle manure, and inorganic sediments. In an active river, they would be subject to scouring and decomposition. However, flows in the Lower Owens River are very slow, facilitating an accumulation of muck. In 1988, Inyo County conducted field surveys along a 32-mile long reach from Mazourka Canyon Road to Keeler Bridge to measure the volume of muck in the channel at over 40 locations.

The County believes BOD values measured in sediments during a sampling event in December 1988 by the County to be the best available data. At that time, 15 samples were collected at various locations along the river. BOD values ranged from 1,100 to 21,000 mg/kg. Ignoring the highest and lowest values, the mean BOD value is 6,910 mg/kg.

These data (Inyo County, unpublished data) were used to estimate average depth, width, and volume of muck, as shown below in Table 4-8.

TABLE 4-8
SUMMARY OF MUCK MEASUREMENTS AT 40 SAMPLING LOCATIONS ON THE LOWER OWENS RIVER

Average Width	Maximum Width	Average Depth	Average Max. Depth	Maximum Depth
37 feet	72 feet	0.42 feet	2.13 feet	4.0 feet

Source: Inyo County Water Dept.

Based on these measurements, the total estimated quantity of muck from Mazourka Canyon Road to Keeler Bridge was 103,700 cubic yards (Inyo County, unpublished data). The estimated quantity from Keeler Bridge to the pump station site (a distance of about 6 miles), utilizing the same average depth and width of upstream reaches, is 19,400 cubic yards. Hence, the total estimated channel sediment quantity along the river downstream of Mazourka Canyon Road is 123,100 cubic yards.

In December 1999, Inyo County collected several organic sediment samples for laboratory analysis (Jackson 1999). Each sediment sample was analyzed for total organic carbon (TOC), sulfides, ammonia as nitrogen, arsenic, lead, silver, zinc, mercury, tannin and lignin, volatile dissolved solids, dissolved methane, and total suspended solids. The channel sediments can be classified as silty clay to silty loam with less than 10 percent organic matter.

A summary of chemical analysis of the channel sediment is provided below in Table 4-9 and key findings are listed below:

- TOC values ranged from 550 mg/kg at Mazourka Canyon Road to 7,660 mg/kg at Keeler Bridge.

- Sulfides were not detected in the sample collected from the Blackrock Ditch sampling site, but were detected elsewhere at concentrations that ranged from 27 mg/kg at Mazourka Canyon Road to 119 mg/kg at the pump station site.

- Concentrations of ammonia measured as nitrogen ranged from 2 mg/kg at Mazourka Canyon Road to 38 mg/kg at the Lone Pine Ponds. A general trend of increasing levels along the river was observed.

- Lead, silver, and mercury were not detected in the sediment samples collected.

- Zinc was detected in some sediment samples at low concentrations.

- Tannin and lignin, derived from plant organic matter, were detected in each sediment sample at concentrations ranging from 3.2 µg/g at Mazourka Canyon Road to 29 µg/g at both Lone Pine Station Road and the Lone Pine Ponds.

- Volatile dissolved solids (VDS) were detected in each sediment sample from 1.5 percent at the Mazourka Canyon Road to 30.2 percent at Lone Pine Ponds. Generally, VDS increased downstream.

- Arsenic was detected in all the sediment samples with a maximum concentration of 6.8 mg/kg from samples at Blackrock Ditch. Arsenic is a naturally occurring constituent in the river derived from geothermal sources in the headwaters.

- Dissolved methane was detected in all sediment samples with the exception of samples at Blackrock Ditch. Dissolved methane concentrations ranged from 76 µg/kg at Manzanar Reward Road to 18,000 µg/kg at Lone Pine Ponds. Dissolved methane increased from Manzanar Reward Road to Lone Pine Ponds, then dropped significantly for Keeler Bridge (380 µg/kg) and the pump station site (140 µg/kg).

TABLE 4-9
CHEMICAL CHARACTERISTICS OF MUCK SAMPLES ALONG THE RIVER, 1999

Sampling Location	Total Organic Carbon (TOC)	Sulfides	Ammonia as Nitrogen	Arsenic	Zinc	Tannin and Lignin	Volatile Dissolved Solids	Dissolved Methane
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/g	percent	µg/kg
Blackrock Ditch	1,200	ND	3	6.8	11	12	1.7	ND
Mazourka Cyn Rd	550	27	2	1	6.0	3.2	1.5	1,700
Manzanar-Reward	4,810	91	5	4.6	7.5	17	4.0	76
Reinhackle Springs	4,540	65	21	4	ND	15	11.4	91
Lone Pine Station Rd	5,060	39	13	3	5.7	29	19.7	3,900
Lone Pine Ponds	4,050	28	38	2	ND	29	30.2	18,000
Keeler Bridge	7,660	91	11	4	6.6	17	19.28	380
Pump Station Site	6,260	119	14	2	7.0	10	21.1	140

Source: Jackson,1999. Lead, silver, and mercury were not detected in any samples.

4.1.3 Potential Impacts – Water Quality

4.1.3.1 Water Quality Degradation Due to New Flows

The primary water quality concern related to rewatering the Lower Owens River is the potential for project baseflows and seasonal habitat flows to degrade water quality in the current wet reach of the river downstream of Mazourka Canyon Road. The degradation of water quality is expected to primarily relate to lowered DO and increased levels of arsenic, turbidity, total suspended solids, hydrogen sulfide, and ammonia.

This section describes the potential effects to water quality that could result from the release of flows as proposed under the LORP. The assessment of effects is based on observations of various water quality parameters made during the 1993 experimental release study. These observations are useful for predicting what conditions are likely to reoccur when project flows are initiated in the Lower Owens River.

Water Quality during Planning Study Releases (1993)

Between July 6 and August 12, 1993, Inyo County and LADWP (with the approval of California Department of Fish and Game) conducted an experimental study to develop predictions of fish and wildlife habitat that would be created in response to various flows. In addition, Inyo County and LADWP collected water quality and flow measurements at nine gaging stations (Jackson, 1994a). Over a period of about 38 days, water was released into the river channel, primarily from the River Intake and Alabama spillgates.

Water was released initially from the River Intake, and subsequently from five spillgates located downstream. The initial flow was approximately 20 cfs and was rapidly increased to 155 cfs (day 15). The flows were subsequently reduced, until the normal summer flow regime (of 1 to 5 cfs at Keeler Bridge) was reestablished 40 days after the initial release. Typical hydrographs for two of the sampling stations are shown on Charts 4-6 to 4-9, indicating a rapid ramping to the peak flows, followed by a rapid then steady decrease.

Five water quality parameters were measured on a near-daily basis: DO, turbidity, pH, electrical conductivity and temperature (Jackson, 1994a). The range and mean values for the five parameters are shown in Table 4-10 for the nine gaging stations. Measurements of DO and temperature at two of the gaging stations are shown on Charts 4-6 to 4-9.

TABLE 4-10
WATER QUALITY ALONG THE LOWER OWENS RIVER DURING THE 1993 EXPERIMENTAL RELEASES

Sampling Site and Miles from Intake	Mean Values (range in parentheses)				
	Dissolved Oxygen (mg/l)	Turbidity (NTU)	pH	Elec. Cond. (*m*ohms /cm)	Temperature (F)
River Intake 0 mi	6.4 (4.2-7.4)	19 (7.6-44)	7.7 (7.2-8.5)	0.28 (.22-.33)	71 (67-75)
East of Goose Lake 11. 4 mi	6.1 (4.2-8.7)	1.9 (1.1-4.8)	7.7 (7.1-8.4)	0.37 (.23-.66)	75 (64-83)
Five Culverts 17.3 mi	2.6 (0.8-5.6)	1.5 (0.8-4.7)	7.3 (7.1-7.6)	0.38 (.29-.75)	72 (64-79)
Mazourka Cyn Rd 23.4 mi	3.0 (1.6-6.3)	1.4 (0.6-2.7)	7.2 (6.8-7.6)	0.39 (.27-.54)	71 (64-79)
Manzanar-Reward Rd 32.2 mi	2.8 (0.4-6.4)	1.3 (0.7-2.9)	7.1 (6.7-7.4)	0.41 (.35-.55)	71 (65-77)
Reinhackle Spring 38.7 mi	2.3 (0.3-5.9)	2.0 (0.1-11)	7.2 (6.8-7.4)	0.43 (.29-.50)	71 (65-76)
Lone Pine Ponds 48.8 mi	1.1 (0.2-5.8)	9.8 (1.2-31)	7.2 (6.5-7.4)	0.63 (.48-.84)	72 (66-76)
Lone Pine Narrow Gauge Rd, 49.7 mi	1.3 (0.2-4.8)	12.0 (1-39)	7.2 (6.8-7.6)	0.63 (.49-.91)	71 (64-75)
Keeler Bridge 55.7 mi	2.1 (0.3-6.5)	2.4 (1-5.6)	7.2 (7.1-7.5)	0.68 (.52-.96)	71 (66-80)

Source: Jackson,1994a. Interested readers should consult Jackson (1994a) for standard deviations.

The mean turbidity at the sampling sites was generally 2.0 NTUs or less except in the lower reaches below Lone Pine Ponds where it varied from 9.8 to 12.0 and at the River Intake. The pH values were between 7.1 and 7.7 over the entire river reach. Mean daily temperature was about 71 degrees F (slightly higher than the August 1999 field sampling), and was very consistent among sampling sites. Electrical conductivity (EC) increased with distance along the river during the study. EC was used to estimate the concentration of total dissolved solids (TDS). The data indicate that maximum TDS concentrations were less than 600 mg/L throughout the river reach. Average TDS concentrations were over 400 mg/L at Keeler Bridge, about 400 mg/L at Lone Pine and less than 300 mg/L upstream of Reinhackle Spring.

The DO levels at Mazourka Canyon Road were between 2 to 3 mg/l when flows reached about 50 cfs, but never dropped lower even with flows up to 90 cfs (Chart 4-6). DO levels dropped below 2 mg/l briefly, after peak flows had dropped back down below 35 cfs, near day 30, then increased over the next 20 days. At Keeler Bridge, DO levels decreased with increased flow rate (Chart 4-8). However, when flows were greater than 60 cfs, the DO concentration dropped to below 1 mg/L, and remained low through the experimental releases, increasing toward the end of the study period, as flows decreased.

In addition to measuring the five water quality parameters, on August 5, 1993 (day 31 of the study), LADWP and Inyo County collected samples when the lower portion of the river was flowing at about 40 cfs. These samples were analyzed for hydrogen sulfide, ammonia, and suspended solids. The key results are as follows:

- The concentration of hydrogen sulfide measured in the river below Mazourka Canyon Road exceeded concentrations considered lethal to bluegill (LADWP, unpublished data). Hydrogen sulfide is extremely toxic to fish. For example, the 96-hour LC_{50} for adult bluegill at 67- 68 degrees F is 0.045

mg/l (as quoted in Jackson, 1994a). Total hydrogen sulfide concentrations measured on August 5, 1993, ranged from 0.18 to 0.65 mg/l (Jackson, 1994a).

- Ammonia is also toxic to fish. The concentrations of total ammonia and un-ionized ammonia were measured on August 5, 1993 of the field experiment, when flows were about 40 cfs (Jackson, 1994a). The measured values were below EPA thresholds for coldwater fish. However, Jackson (1994a) speculates that higher unionized ammonia levels that were not detected in the sampling may have been present at high flows during the 1993 study.

Based on the observed water quality, it is clear that the flows released to the river during the 1993 experimental flow study were the cause of degraded water quality and subsequent fish kills that occurred in the river downstream from Mazourka Canyon Road. DO and hydrogen sulfide in this reach of the river were at levels toxic to the fishery. Given the existence of toxic material in the organic streambed sediments, it is possible that the observed water quality effects resulted from the interaction of the study flows with the sediments. Although the precise mechanisms by which the flow study caused the fish kills and the hydraulic thresholds that triggered the water quality degradation are unknown, it is likely that, when project flows are initiated in the future, such conditions could reoccur.

It should be noted that the 1993 field experiment was of short duration, which did not allow sufficient time to stabilize flows or water quality. Hence, the potential for water quality conditions to improve under more stable flows was not evaluated. It is possible that the poor water quality conditions observed in 1993 could have improved after several weeks of stabilized flows. However, because the flow study did not last long enough to allow the improvement of water quality with higher river flows, it is not possible to predict how long water quality effects would occur under the project flows.

The predictions of water quality impacts based on the 1993 field experiment do not take into account ambient air and water temperatures. The 1993 field experiment was conducted in mid-summer when high temperatures could have exacerbated the increase in BOD and off-gassing from the organic sediments. Releases in the winter could inhibit these reactions and thus reduce the magnitude of the water quality impacts.

Chart 4-6. Dissolved Oxygen at Mazourka Canyon Station During 1993 Experimental Releases

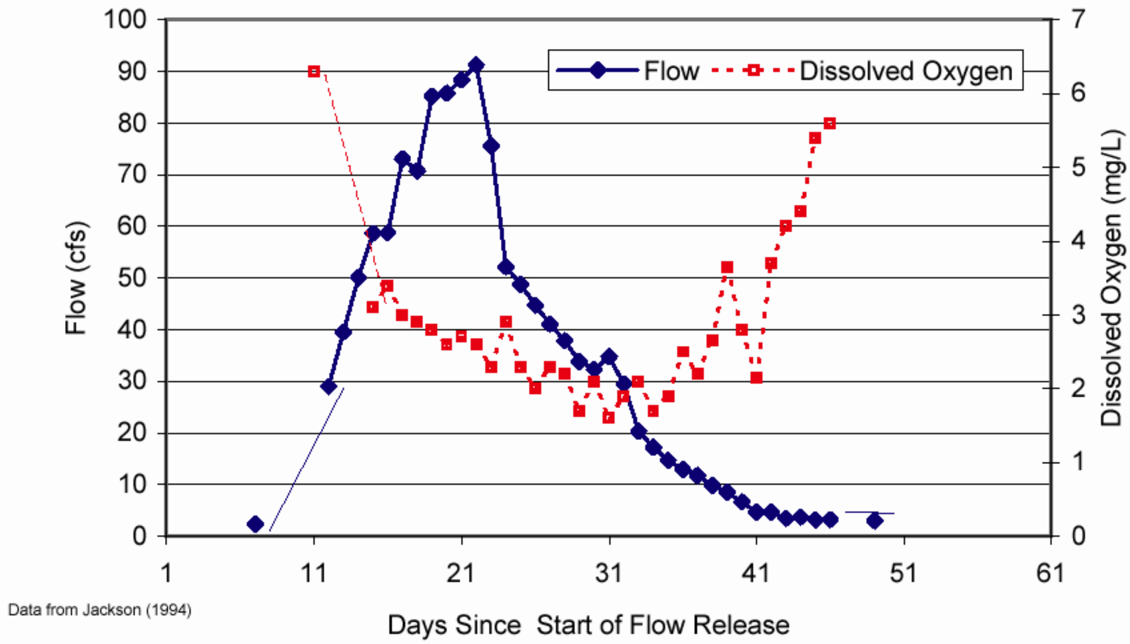
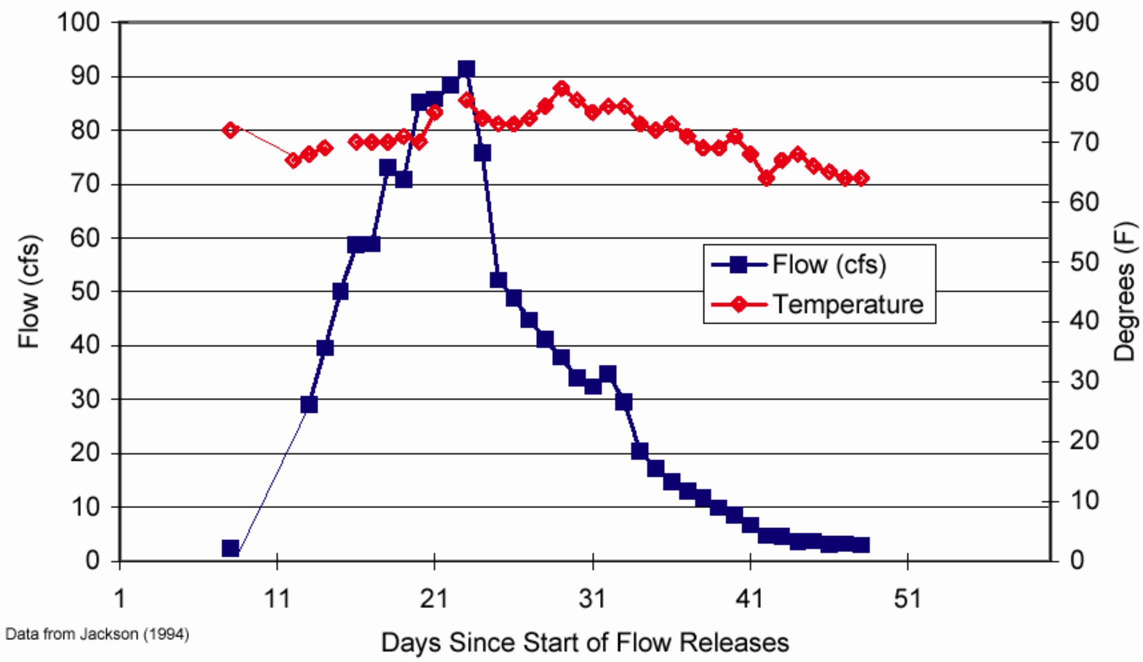


Chart 4-7. Temperature at Mazourka Canyon Station During 1993 Experimental Releases



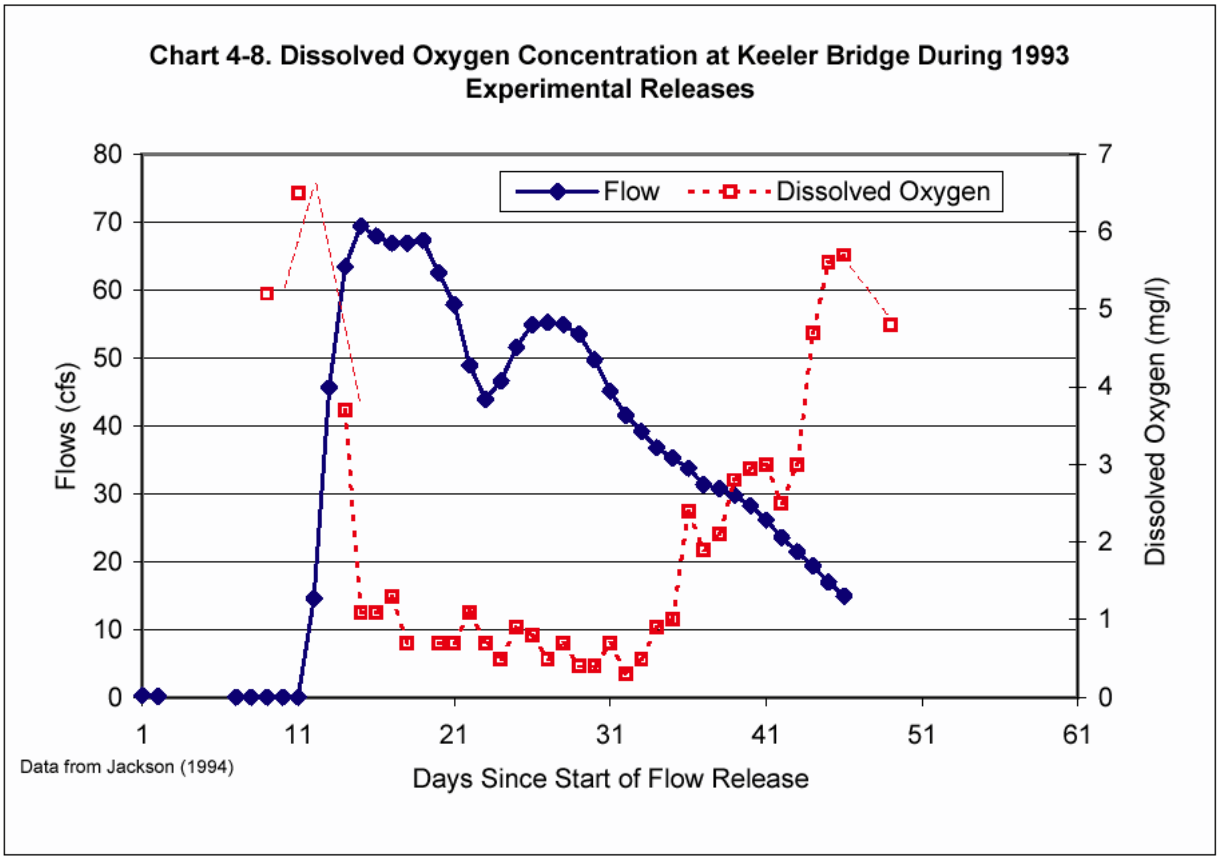


Chart 4-8. Dissolved Oxygen Concentration at Keeler Bridge During 1993 Experimental Releases
Flow
Dissolved Oxygen
Flows (cfs)
Dissolved Oxygen (mg/l)
Days Since Start of Flow Release
Data from Jackson (1994)
0
10
20
30
40
50
60
70
80
1
11
21
31
41
51
61
0
1
2
3
4
5
6
7

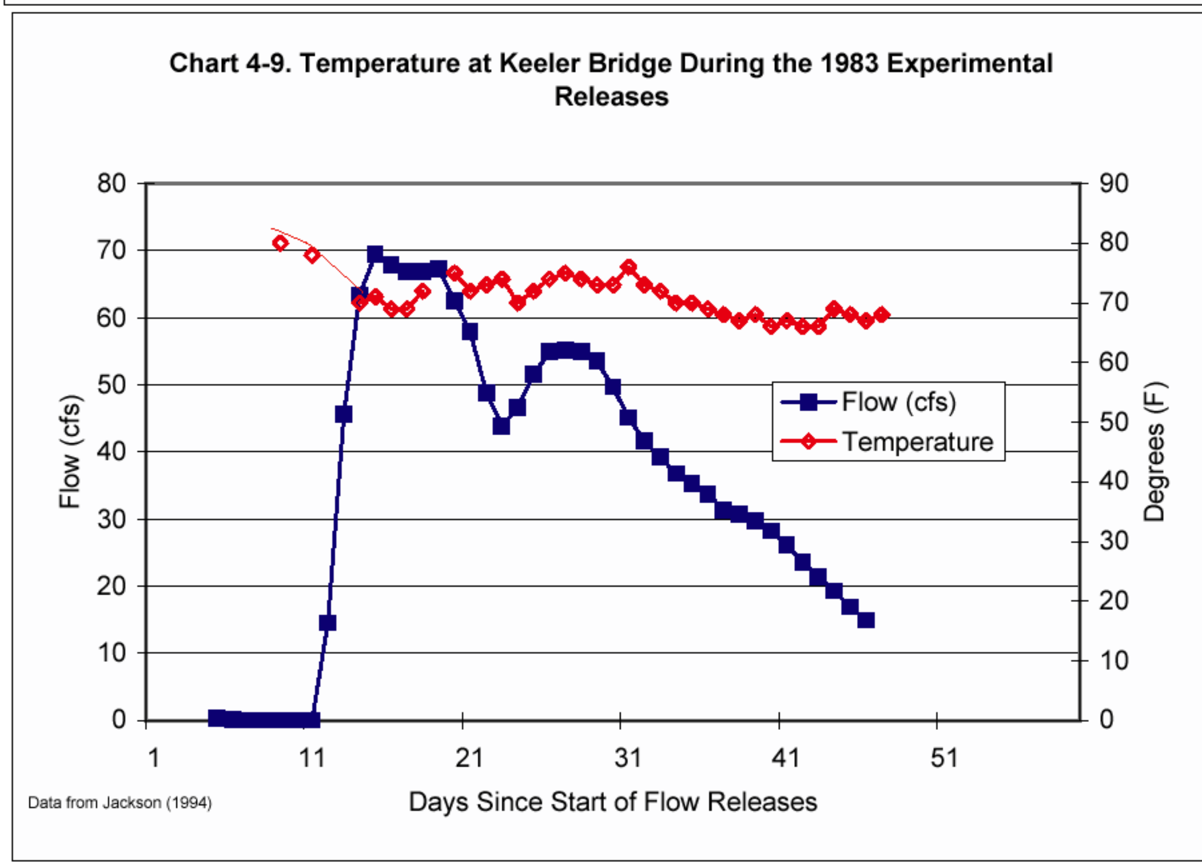


Chart 4-9. Temperature at Keeler Bridge During the 1983 Experimental Releases
Flow (cfs)
Temperature
Flow (cfs)
Degrees (F)
Days Since Start of Flow Releases
Data from Jackson (1994)
0
10
20
30
40
50
60
70
80
90
1
11
21
31
41
51

Other Water Quality Observations – Aqueduct Cleaning

LADWP released water from the Alabama spillgates from August 15 to 27, 2001 while the Aqueduct was being cleaned. No flow measurements were made, but LADWP staff estimates that the flow rates from the spillgates reached about 24 cfs within several days. Water quality measurements were taken at the Alabama spillgates, Lone Pine Ponds, Lone Pine Station Road, Keeler Bridge, and below Keeler Bridge. Constituents measured included temperature, dissolved oxygen, electrical conductivity, turbidity, and pH (LADWP, unpublished data).

Dissolved oxygen concentrations were substantially higher in water released from the Aqueduct at the Alabama spillgates than in the Lower Owens River stations. DO levels were 7 mg/l and higher at the Alabama spillgates compared to along the river, where DO levels were 1 to 4 mg/l, with most measurements less than 2 mg/l. The releases from the Alabama spillgates on August 15, 2001 took several days to reach Keeler Bridge. The increased flows in the river apparently did not affect DO levels, as there was no overall decrease in DO concentrations along the river due to the new flows. Electrical conductivity levels exhibited a similar pattern: very low values in water from the Aqueduct compared to higher values in the river, with no trend in increasing conductivity with the release of water to the river. Turbidity levels in Aqueduct water and in the river were similar and very low (2 to 3 NTUs) throughout the release period and did not exhibit an increase as flows reached the downstream stations.

Other Water Quality Observations - Impacts from Beaver Dam Removal

On August 2, 2001, LADWP, Inyo County, and CDFG removed six beaver dams along the Owens River between the Alabama spillgates and Lone Pine Station Road. The dams were removed using a claw-like device suspended from a helicopter, which lifted the centers of the dams and deposited the materials in nearby upland areas. Jackson (2001) made measurements of the following water quality parameters above and below the dam removal sites immediately before and after the action: temperature, dissolved oxygen, electrical conductivity, and turbidity.

Flows of up to 7 cfs were induced by the breaching of the dams. Small turbid plumes were created downstream of the beaver dams during removal if open water was present. The plumes terminated within 150 feet of the dam removal site (Jackson, 2001). Jackson (2001) reported that taking samples from the river channel caused more turbidity than the dam removal.

Jackson (2001) reports that there was no noticeable decrease in dissolved oxygen during the dam removal process. In fact, the increased flows from breaching a dam often increased dissolved oxygen levels below the dams, apparently due to aeration of the water. Jackson (2001) also reports that there were no significant changes in electrical conductivity due to dam breaching. These data indicate that the method of dam removal employed in August 2001 and the increased flows of up to 7 cfs had only a negligible effect on water quality.

Water Quality Modeling

Based on the results of the 1993 flow study, water quality conditions in the river under the 40-cfs baseflow were predicted using the QUAL2E model (Technical Memorandum #7, Ecosystem Sciences, no date). The model provided predictions for eleven water quality parameters at eight reaches along the River. Predicted values of parameters related to fish health were: 2.5 to 6.1 mg/L for DO; 71 to 80 °F for temperature; and 0 to 0.04 mg/L for ammonia as nitrogen. Predicted DO values for several reaches were below 5 mg/L, which is the 1-day minimum threshold for warmwater fish species in early life stages. Predicted ammonia concentrations were well below levels toxic to fish. Hydrogen sulfide was not one of the parameters predicted by the model.

The 1993 flow study represented worst case conditions for dissolved oxygen since it was conducted in the summer and the increased flows mobilized organic materials from the channel bottom and the floodplain. While the results of the QUAL2E model also represent worst case predictions in some respect, the use of the model as a predictive tool for changes in water quality conditions under LORP is limited since the 1993 flow study did not reflect equilibrium conditions.

Impact Conclusions

Based on the available data and analytic tools, it appears that the proposed 40-cfs baseflow and seasonal habitat flows could degrade water quality and adversely affect fish due to the depletion of oxygen and the possible increase in hydrogen sulfide and ammonia. These impacts are only expected to occur along the wetted reach of the river where the organic sediment deposits are present, affecting about 37 channel miles of the 62-mile length of the river. It is anticipated that water quality conditions will improve under the 40-cfs baseflow over time, but may be subject to periodic disturbance by the seasonal habitat flows of up to 200 cfs. The time required to stabilize water quality under the baseflow and seasonal habitat flows is unknown. Based on the analysis presented herein, it is speculated that the impacts would diminish with time and continual flows in the river. Eventually, water quality conditions in the river are expected to improve over current conditions. Over the long-term, increased water availability should improve overall conditions for realizing an increase in beneficial use of the water (mainly increased habitat).

As described in Section 2.3.5.3, the first seasonal habitat flow will be released in the winter (i.e., when temperatures are lower) to reduce the potential for substantial decreases in dissolved oxygen and adverse effects on fish health. However, the effectiveness of the first seasonal habitat flow to reduce water quality impacts during subsequent seasonal habitat flows (scheduled to occur in May/June) is uncertain. In addition, there is still a potential for significant water quality impacts to occur during the establishment of the 40-cfs baseflow.

Additionally, the proposed spillgate releases (see Sections 2.3.5.2 and 2.3.5.4) are designed to provide fish with refuge areas of higher quality water (higher DO, lower turbidity) at the confluences of spillgate channels with the river channel. Spillgate releases are not intended to improve water quality throughout the river. The spillgate releases will not be of velocities high enough to cause additional stirring of organic sediments. In addition, the ditches downstream of the spillgates are maintained and do not contain substantial amounts of organic sediments. Therefore, spillgate releases are not expected to further depress DO as a result of sediment disturbance.

The proposed baseflow and seasonal habitat flows could cause water quality degradation along the Lower Owens River from Mazourka Canyon Road to the pump station site. **This impact is considered significant and unavoidable (Class I).** The poor water quality conditions would adversely affect the following beneficial uses: Cold Freshwater Habitat, Warm Freshwater Habitat, Commercial and Sportfishing, Non-Contact Water Recreation, Wildlife Habitat. Water quality conditions could result in fish kills. The following water quality objectives may not be met during this period: Biostimulatory Substances, Chemical Constituents, Dissolved Oxygen, Floating Materials, Non-Degradation of Aquatic Communities and Populations, Sediment, Settleable Materials, Suspended Materials, Taste and Odor, Temperature, and Turbidity. There is potential for toxic substances to be released to the water in deleterious amounts – in particular, naturally-occurring hydrogen sulfide and ammonia. The impacts associated with a slower release of flows to the river are discussed in Section 11.3.

Based on recommendations by the Regional Board (NOP letter dated February 24, 2000), stilling ponds were evaluated as a potential mitigation measure for reducing short-term water quality impacts. However, this measure was determined to be infeasible as described below:

- The use of stilling ponds to capture and settle out sediments could reduce the turbidity effects of initial flow releases. However, this strategy is considered infeasible since it would reduce the ability of seasonal habitat flows to spread channel sediments onto the floodplains. The spreading of sediments onto the floodplains is necessary for riparian habitat development, and is an objective of seasonal habitat flows stated in the MOU.

4.1.3.2 Water Quality Impacts from Channel Clearing and Tule Removal

As described in Section 2.3.6, LADWP will remove channel sediments and vegetation in the river channel immediately downstream of the River Intake prior to the initial release of water. The physical disturbance to these sediments may cause water quality impacts when the initial releases are made because there will be loose sediments and vegetative debris. However, channel sediments in this currently dry reach of the river consist primarily of unconsolidated sand and contain less organic matter than in the currently wetted reaches below Mazourka Canyon Road. Therefore, water quality impacts in this reach during initial releases are expected to be short-term and localized compared to the currently wetted reaches. **Hence, this water quality impact is considered less than significant (Class III).**

As described in Section 2.3.9, the LORP does not include mechanical removal of sediments once the river is flowing. In addition, limited stands of cattail and bulrush will be removed only on rare occasions and only if they are causing significant flow constrictions along the river or at culverts, or if they significantly impede the goals of the LORP (see Section 2.10).

The removal of cattail and bulrush stands could cause localized water quality impacts. Mechanical removal of cattail and bulrush stands would involve the use of a Gradall® or clamshell bucket working in the wetted channel. The physical excavation of the vegetation, including the root mass, would cause increased turbidity and suspended sediments at and downstream of the work areas. In addition, it is likely that the excavated sediments associated with the root mass could increase biochemical oxygen demand, reduce dissolved oxygen concentrations, and increase concentrations of undesirable constituents such as ammonia and sulfur compounds. The water quality impacts are expected to be temporary and localized, similar to those observed during beaver dam removal (see above). Water quality conditions are expected to improve within hours as suspended sediments settle to the channel bottom and/or are mixed with better quality water downstream. **The short-term and localized degradation of water quality associated with a cattail and bulrush removal operation is considered an adverse, but not significant impact (Class III).** LADWP would employ standard best management practices under a CDFG 1602 Streambed Alteration Agreement to further reduce this impact.

4.1.4 Mitigation Measures

No mitigation measures are considered feasible to reduce or avoid the significant temporary water quality impacts associated with the initial release regime for the 40-cfs baseflow and seasonal habitat flows.

Mitigation measures to reduce impacts to fish are described in Section 4.6.3. Three alternative release regimes are described in Section 11.3.

4.5 WETLANDS AND RIPARIAN HABITAT

4.5.1 Existing Conditions

The following description of vegetation along the river was prepared by White Horse Associates. Vegetation types in the Lower Owens River corridor were mapped by White Horse Associates from 1:12,000 scale aerial photos dated July 1992 and reported by Ecosystems Sciences (1997). White Horse Associates is currently re-mapping the same area from digital orthophotos dated September 2000. Major vegetation types identified in the earlier study were coupled with preliminary field descriptions of vegetative, soil and hydrologic character from the latter study. Vegetation and miscellaneous types adapted from the former study are presented below and generally ordered from wet to dry. The wetland status of vegetation types was surmised from descriptions of vegetation, soil and hydrology in areas representative of each type.

Marsh/wet alkali meadow: This complex map unit consists of extensive marsh and wet alkali meadow vegetation types that occur on the wetted floodplain of the Lower Owens River. Dominant plant species in marsh include common cattail (*Typha latifolia*), southern cattail (*Typha domingus*), tule bulrush (*Scirpus acutus*), and common reed (*Phragmites australis*). Widely scattered tree willows (*Salix goodingii* and *S. laevigata*.) are often included. Dominant plants in wet alkali meadow include common threesquare (*Scirpus pungens*), annual sunflower (*Helianthus annuus*), Baltic rush (*Juncus balticus*), saltgrass (*Distichlis spicata*) and clustered field sedge (*Carex praegracilis*). Hydric vegetation is present in both marsh and wet alkali meadow. Marsh is typically permanently flooded to saturated; wet alkali meadow is typically saturated at or near the surface. Wetland hydrology and soil are evident. These vegetation types are classified as wetlands, and are categorized as transmontane alkali marsh and rush/sedge Holland types.

Riparian forest: This vegetation type occurs mostly within the wet floodplain and, less extensively, on banks immediately adjacent to the wet floodplain. The tree canopy is dominated by black willow (*Salix goodingii*) and/or red willow (*Salix laevigata*). Scattered Fremont cottonwood (*Populus fremontii*), saltcedar (*Tamarix ramosissima*), and Russian olive (*Elaeangus angustifolia*) may be present. On wet floodplain a marsh understory is typically present and trees are decadent; water regimes are permanently flooded to saturated and hydric soils are evident. Along elevated streambanks understories are similar to alkali meadow, groundwater is typically less than 2 feet deep and hydric soils may be evident. These communities are classified as wetlands. Given existing hydrologic conditions and the absence of streambars, tree willows are not currently reproducing. In the course of 10 days of field study, not one tree willow seedling was found, except along the dry sandy streambed in the upper reach. Riparian forest is included in the Modoc-Great Basin cottonwood/willow and Mojave riparian forest Holland types.

Alkali meadow: This vegetation type occurs on floodplain and low terrace of the Lower Owens River corridor. The dominant plant species is saltgrass, sometimes complimented by alkali sacaton (*Sporobolus aeroides*) and beardless wild rye (*Leymus triticoides*). Scattered rubber rabbitbrush (*Chrysothamnus nauseosus*) and Nevada saltbush (*Atriplex lentiformis*) may be present, especially on low terraces. The alluvial groundwater level for alkali meadow that occurs on floodplains is typically less than 2 feet below the surface and hydric soils are evident – these alkali meadow types are wetland. The groundwater level for alkali meadow that occur on low terraces is typically greater than 3 feet deep and indices of hydric soil are not evident – these are uplands. Alkali meadow on low terraces is mostly alkali scrub/meadow that has burned recently. In a current study of vegetation types along the Lower Owens River corridor, about a third of the alkali meadow occurred on floodplain and was considered wetland and the remaining two-thirds was considered upland. This corresponds with the alkali meadow Holland type.

Alkali scrub meadow: This vegetation type occurs on low terraces along the Lower Owens River. A low shrub overstory is typically dominated by rubber rabbitbrush and Nevada saltbush. Saltgrass and alkali sacaton are prominent in the understory, typically with greater than 50 percent total cover. The alluvial groundwater level is typically 3 feet or deeper. Hydric soils are not evident. This is an upland vegetation type. Burning converts alkali scrub/meadow to the non-wetland alkali meadow type. This corresponds with the rabbitbrush meadow and Nevada saltbush meadow Holland types.

Saltcedar scrub: This vegetation type occurs mostly on high terraces, but also occurs along the floodplain and low terraces in the upper reach that is dry. Saltcedar is the dominant overstory. The understory is sparse. Wetland hydrology and hydric soil are not evident. These are upland types. This corresponds with the tamarix scrub Holland type.

Alkali scrub: This vegetation type occurs on high terraces and fans along the Lower Owens River. A low shrub overstory is typically dominated by greasewood (*Sarcobatus vermiculatus*), rubber rabbitbrush, and/or Nevada saltbush, in both mixed and pure stands. The understory is very sparse. Groundwater is typically 5 feet or deeper. Hydric soils are not evident. Alkali scrub is an upland. This corresponds with the greasewood scrub, rabbitbrush scrub and Nevada saltbush scrub Holland types.

4.5.2 Potential Impacts – Vegetation

Anticipated Conversions in Vegetation Types

Ecosystem Sciences (unpublished data, October 2001) conducted an analysis of the expected change in vegetation types due to the increased baseflows and seasonal habitat flows in the river. In the study, future vegetation types along the Lower Owens River were predicted based on: (1) HEC-2 hydrologic analyses; (2) existing landform and vegetation types mapped from 1993 aerial photos; and (3) elevations estimated along cross-channel transects. Based on these investigations, the distribution of vegetation types was predicted in the area that will be affected by the 40 cfs baseflow and 200 cfs seasonal habitat flows. The 200 cfs modeling was conducted based on the premise that 200 cfs would be achieved along the entire river reach, so the extent of overbank flooding is likely to be less under the proposed project.

The acreages of existing vegetation types along the river are shown in Table 4-11. The table shows the vegetation types in general progression from wet to dry. The predicted habitat conversions that would occur over time due to the 40 cfs baseflows and 200 cfs seasonal habitat flows are also shown. The results of Ecosystem Sciences (unpublished data, October 2001) are summarized below.

- Existing herbaceous wetland vegetation types (marsh/wet alkali meadow, and alkali meadow) would increase substantially due to greater availability of water from flooding and lateral diffusion. The area of herbaceous wetland was predicted to increase from 559 acres to 2,631 acres.
- New riparian forest would be created as willows and cottonwood colonize barren streambars, mostly in the dry reach above Mazourka Canyon Road and, less extensively, existing wetlands and riparian habitats along the wet reach of the river to the south. It was estimated that an additional 854 acres of riparian forest will be created over time. However, given the extensive existing and future flooding and the absence of streambars necessary for establishing new riparian forest in the Lower Owens River, these estimates may be optimistic. These would be considered wetlands under the Holland classification system. If hydric soils and wetland hydrology and vegetation are present, they would also be considered wetlands under the Corps of Engineers' wetland definition.

- Alkali scrub meadow totaling 2,343 acres is predicted to be converted to various wetland and riparian vegetation types due to altered hydrologic conditions along the river. This would be the largest single habitat conversion due to the rewatering of the river.

The vegetation goal for the Riverine-Riparian System from the MOU is to "…*create and sustain healthy and diverse riparian and aquatic habitats*…" To meet the requirements of the MOU, the habitats must be as self-sustaining as possible. Increased flows in the Lower Owens River are expected to increase the productivity of wetland and riparian vegetation types, and cause type conversions. The new flows are expected to increase plant productivity due to greater moisture availability. In addition, natural disturbance from the seasonal habitat flows will promote natural reproduction and recruitment, as well as facilitate natural vegetation succession through physical disturbances that encourage species colonization and cause turnover of nutrients and carbon. Hence, a "healthier" riparian system is anticipated, as required under the MOU.

Over time, the rewatering of the river is predicted to convert about 2,343 acres of alkali scrub/meadow (an upland vegetation) and 531 acres of alkali meadow (upland phase) to various wetland and riparian vegetation types due to inundation effects and altered hydrologic conditions along the river. In considering the significance of the conversion of the approximately 3,000 acres of upland vegetation to wetland and riparian vegetation types, LADWP considered the following:

- Within the context of the total acreage of upland vegetation in Owens Valley, the upland acreage to be converted under LORP is a relatively small percentage of the total area. The total acreage of alkali meadow (upland phase) and alkali scrub/meadow type vegetation in the Owens Valley is estimated to be approximately 96,000 acres, or 42 percent of the total area mapped (approximately 227,000 acres) (mapping based on the vegetation inventory in the Green Book (LADWP and Inyo County, 1990)). The loss of a total of 2,874 acres of upland alkali meadow and alkali scrub/meadow type vegetation in the LORP area represents approximately 3 percent of the total acreage present in the Valley.

- Due to changes in hydrologic conditions, implementation of LORP has the potential to increase areas of upland vegetation along the river corridor adjacent to the new riparian areas. Additionally, land management changes proposed under LORP are expected to have an overall beneficial impact on upland habitats. The acreage of this increase/enhancement has not been quantified.

- Riparian and wetland areas created under LORP are expected to have greater habitat values than the existing upland areas that will be converted.

- Other activities are currently ongoing that have the aim of improving upland habitat areas in the Valley. LADWP is implementing upland revegetation projects on 1,300 acres of abandoned agricultural land as part of mitigation identified in the 1991 EIR.

- The conversion would restore native riparian habitats that existed prior to 1913 when diversion of the river into the Aqueduct began.

Therefore, the conversion of almost 3,000 acres of upland vegetation is considered an adverse, but less than significant impact (Class III). The LORP cannot be accomplished without this conversion. The increase of approximately 3,000 acres of wetland and riparian vegetation types along the river **is considered a beneficial impact (Class IV) and desirable outcome of the LORP.**

Vegetation Removal Due to River Channel Clearing

As described in Section 2.3.6, prior to the Phase 1 releases, LADWP will mechanically remove sediments and marsh vegetation from 10,800 feet of the currently dry river channel downstream of the River Intake. A 15-foot wide swath will be excavated within the middle of the existing 40-50 foot wide channel to allow 40 cfs to pass. This action would result in the removal of 3.7 acres of emergent freshwater marsh currently dominated by cattails. **This impact is considered an adverse, but not significant impact (Class III)** because new emergent wetlands will be created over time along the entire Lower Owens River in response to the rewatering, including along the margins of the wetted channel along this reach.

TABLE 4-11
EXISTING AND PREDICTED VEGETATION TYPES ALONG THE RIVER

	Existing Area		Predicted Future Area		Predicted Change	
Vegetation Type	Acres	Percent	Acres	Percent	Acres	Percent
Open water*	629	10.8	640	11.0	11	0.2
Marsh/wet alkali meadow**	293	5.0	1,175	20.2	882	15.1
Riparian forest**	744	12.8	1,598	27.4	854	14.7
Alkali meadow**	266	4.6	1,456	25.0	1,190	20.4
(Total vegetated wetlands)**	1,303	22.4	4,229	72.6	2,926	50.2
Total vegetated wetlands and open water (waters of the US) =	**1,932**	**33.2**	**4,869**	**83.6**	**2,937**	**50.4**
Alkali meadow (upland phase)	531	9.1	0	0.0	-531	-9.1
Alkali scrub/meadow	2,461	42.2	118	2.0	-2,343	-40.2
Saltcedar scrub	178	3.1	166	2.8	-12	-0.2
Alkali scrub	713	12.2	662	11.4	-51	-0.9
Total uplands =	**3,883**	**66.6**	**946**	**16.2**	**-2,937**	**-50.4**
Misc. features (roads, levees) =	**11**	**0.2**	**11**	**0.2**	**0**	**0.0**
TOTAL =	**5,826**	**100.0**	**5,826**	**100.0**	**--**	**--**

Unpublished data from Ecosystem Sciences.
* Open water represents "waters of the United States" under Section 404 of the Clean Water Act, but is not considered "wetlands."
** These vegetation types are usually considered vegetated wetlands under Section 404 of the Clean Water Act if hydric soils and wetland hydrology and vegetation are present.

The channel clearing work would occur from the top of the west bank of the river using a tracked excavator. Both banks will remain undisturbed. Excavated material will be placed directly into dump trucks, and then hauled to a permanent sediment stockpile area adjacent to the River Intake. A temporary 20-foot wide haul road will be established on the top of the west bank for the excavator and trucks. It will be created by driving over the existing vegetation in flat areas, and by minor grading where the terrain is uneven. Several temporary roads will be created perpendicular to the main haul road to provide access to an existing dirt road along the Aqueduct. Establishment of these roads would result in the short-term disturbance of about 8 acres of desert sink scrub. **This impact is considered significant, but mitigable**

(Class II). It would be mitigated by restoring the roads to pre-construction grades and vegetative conditions, per Mitigation Measure R-1.

Noxious Plant Species and Saltcedar

Supplying water to the river 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.

Potential Increase in Mosquitoes

The LORP will results in new open water and marsh habitats along the river. These new habitats would provide more opportunities for mosquitoes to breed, which could result in increased nuisance and public health threats 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 10.3.1.

4.5.3 Mitigation Measures

R-1 Temporary access roads used to clear the river channel shall be seeded with native or naturalized grasses and shrubs common to the valley, as available, after completion of the desilting operation to facilitate restoration of vegetative cover and species compatible with the surrounding vegetation. The colonization by non-native aggressive or noxious weeds shall be inhibited by weed control for 3 years after construction.

4.6 GAME AND NATIVE FISH

4.6.1 Existing Conditions

The following characterization of the native and game fish of the Owens Valley and LORP project area was developed by Garcia and Associates for the EIR/EIS (GANDA, 2000).

Native Fish

Summarized below is a description and qualitative account of the distribution and abundance, habitat preferences and general life-history of the four fish species endemic to the Owens Basin.

Owens Pupfish

The Owens pupfish was federally listed as endangered on March 11, 1967 and was listed as an endangered species by the State of California on June 27, 1971. Owens pupfish are small, deep-bodied fish, approximately 2.5 in. total length (USFWS, 1998). During the breeding season, males and females can be easily distinguished from each other by coloration. Females are dusky, olive green with several dark vertical bars aligned in a row along the sides, and males are bright blue (USFWS, 1998). Owens pupfish can produce multiple generations per year and feed mostly on aquatic insects (Mire, 1993; J. Mire, pers. comm. 2000). Populations studied by Sada and Deacon (1994) demonstrate that adults frequently occupy deeper water than juveniles, but all life stages utilize the variety of microhabitats available.

Mire (1993) conducted extensive research on Owens pupfish demography in intensively managed research ponds, and her data indicate little seasonal variation in population size. However, population numbers may undergo wide variations outside of controlled habitats (USFWS, 1998).

Owens pupfish once occupied aquatic habitats throughout the Owens Valley, preferring the margins of marshes, shallow sloughs and desert springs bordering the Owens River. They were not reported from Owens Lake (Miller and Pister, 1971; USFWS, 1998). The pupfish populations rapidly declined due to the introduction of non-native, predatory fish (e.g., bass) that out-competed the native species, and when native aquatic habitats were altered by groundwater pumping and water diversions from the Owens River and its tributaries. Owens pupfish were believed to be extinct from 1942 (Miller, 1969) until July of 1964, when a single population of approximately 200 fish was discovered in Fish Slough (Miller and Pister, 1971). All extant populations have been propagated from this remnant stock.

Within the LORP area, an isolated, self-sustaining population of Owens pupfish exists near Well 368 in the Blackrock lease (see Section 9.2.1.2; Ecosystem Sciences, 1999; Malengo, 2000). This population was introduced to the outflow of the well in 1986 (Malengo, 2000). Other self-sustaining populations in close proximity to the LORP occur in refuges at Mule Spring and Warm Springs. Populations in the Owens Valley Native Fish Sanctuary in Fish Slough appear to have been extirpated by bass predation (Malengo, 2000). Adjacent to the Native Fish Sanctuary, there are populations below BLM Springs and at Marvin's Marsh (Parmenter, 1999). The pupfish in these locations are physically separated from the main channel (S. Parmenter, pers. comm., 2000). All known populations of pupfish are established in areas isolated from non-native predatory fish (i.e., bass).

Owens Tui Chub

The Owens tui chub was federally listed as endangered on August 5, 1985 (50 FR 31592) and by the State of California on January 10, 1974 (USFWS, 1998). Owens tui chub average about 4 to 5 inches in total length (BioSystems, 1994), although some individuals may reach a total length of 12 inches (USFWS, 1998). Coloration varies from dusky olive above, with a blue or creamy white belly, and copper or gold along the sides of the body (BioSystems, 1994). Owens tui chub can be separated from the similar Lahontan tui chub by several anatomical features, including the number of anal fin rays, gill raker counts of 10 to 14, and 52 to 58 lateral line scales (Miller, 1973). Breeding habits of the Owens tui chub are not well known, although spawning is likely to take place during the spring, with females laying their eggs in shallow water over beds of vegetation. McEwan (1990) observed that Owens tui chub prefer pool habitats with low current velocities and dense aquatic vegetation that provide adequate cover and habitat for insect food items.

Owens tui chub were historically distributed throughout the Owens River basin, including Owens Lake (USFWS, 1998). Currently, few populations of genetically-pure Owens tui chub are thought to exist, and occur only where suitable habitat is isolated from non-native fishes (particularly Lahontan tui chub and predatory fish) (USFWS, 1998). No known populations exist within the LORP area.

The introduction of non-native fish species and water diversion for agricultural and municipal use have been the principal factors negatively affecting Owens tui chub (BioSystems, 1994; USFWS, 1998). In addition, hybridization with Lahontan tui chub is a serious threat to the genetic integrity of this species.

Owens Speckled Dace

Owens speckled dace is a California Species of Special Concern. Owens speckled dace reach a total length of approximately 4 inches. This species feeds on insects throughout the water column and spawns in the spring over gravel substrates (D. Sada, pers. comm. 2000). Owens speckled dace appear to be habitat generalists, and population numbers may undergo dramatic seasonal fluctuations (D. Sada, pers. comm. 2000).

Owens speckled dace historically occupied springs and streams (including the Owens River and Fish Slough) throughout the Owens Valley, Long Valley, and Benton Valley, and springs at Little Lake (Sada 1989). Predation by non-native fishes and habitat alteration by impoundment and disruption of valley-floor spring discharge by groundwater pumping caused the Owens speckled dace to disappear from most of its historical range (Sada, 1989; D. Sada, pers. comm. 2000). There are no known populations of Owens speckled dace within the LORP area (D. Sada, pers. comm. 2000).

Owens Sucker

The Owens sucker is a California Species of Special Concern. The Owens sucker may reach a length of 18 inches (Sigler and Sigler, 1987). It is colored slate gray on the back, fades to faint blue reflections laterally (particularly on breeding males), then to a dusky white belly. Owens suckers have a subterminal mouth, thick caudal peduncle, large head and long snout, and large scales (USFWS, 1998). It is closely related to the Tahoe sucker *(C. tahoensis)*, a widely distributed species in the Lahontan basin of northeastern California and northern Nevada. This is the only fish native to the area that can successfully compete with introduced species.

Little quantitative information exists on Owens sucker habitat requirements, life history, abundance, or current distribution. Information on the biology and ecology of Tahoe sucker is generally used to describe the life history requirements of the Owens sucker. Owens suckers probably spawn from May through July within the river and, like Tahoe suckers, they probably require gravel substrates in fluvial habitats for spawning (Moyle, 1976). Owens suckers are omnivorous and consume invertebrates, vegetation, and detritus from the substrate. Dienstadt et al. (1985; 1986) reported that Owens suckers in fluvial habitats were most common in runs located where riffles are small and scarce. In lakes, larval and juvenile Owens suckers occupy shallow littoral habitats (Miller, 1973).

Owens suckers were widely distributed throughout the Owens Basin and generally closely match historic distributions of other native fishes. Owens suckers have been recorded from Crowley and Convict Lakes in the upper Owens River drainage, and in Owens Valley from Bishop Creek, Rock Creek, irrigation canals near Bishop, and the Owens River through Pleasant Valley (MacMillen et al. 1996). No known populations of Owens suckers are found in the LORP area (D. Sada, pers. comm. 2000).

Non-Native Fish

Water developments in the Owens Valley, including some prior to and since the City of Los Angeles' completion in 1913 of the Aqueduct that diverts the Owens River, altered the aquatic habitats within the valley. Shortly after completion of the Aqueduct, the river below the Intake had become a dry channel, with the exception of a few isolated spring holes (P. Pister, pers. comm. 2000). During the 1960s, several lakes adjacent to the river were enhanced to provide recreational opportunities (P. Pister, pers. comm. 2000). These were enhanced through a verbal agreement between LADWP and CDFG. A recreational warmwater fishery was established in these off-channel lakes and ponds, dating from at least the 1960s. These lakes were fed, through an elaborate connection of ditches, by water from the Blackrock and Thibaut spillgates. LADWP has continued these releases through voluntary releases prior to any formal agreements, and under the Lower Owens River Rewatering Project, which was initiated in 1986.

Water from these lakes found its way into the river channel, primarily through the Billy Lake return. Warmwater fish introduced by CDFG for angling were distributed throughout the off-channel lakes and ditches and into the river below the Billy Lake return. CDFG no longer stocks these off-channel lakes.

Mosquitofish were probably introduced for mosquito control. The present conditions in the river include a wetted channel from the Billy Lake return to the Delta.

The wet reach of the Lower Owens River is colonized by beaver, which are an exotic species introduced to the valley. The Lower Owens River is highly suitable for beaver due to its low gradient, low flows, and mild winters. The dominant aquatic habitats within the river channel are beaver ponds and marsh-type areas. Beaver ponds are typically 6 to 7 feet deep and up to several hundred feet long. In addition to the beaver ponds, there are many other aquatic areas in the channel that harbor non-native fish. Tules are common in most areas of the channel with flowing or standing water, usually forming dense, impenetrable stands in the wetted channel.

The current aquatic habitats within the river channel have been colonized by introduced fish that originated from the off-channel lakes and ponds and the Aqueduct. Information on the distribution and abundance of the current species within the LORP has been gathered from several sources, including Parmenter (1989), Hill et al. (1998), Ecosystem Sciences (1999), Lone Pine Warmwater Fishing Association (2000), and GANDA (2000a; 2000b).

Information on the fish community has also been collected subsequent to fish kills observed during flow releases from the Aqueduct in August 1989 (Parmenter, 1989) and in 1993 (Hill et al. 1998). In early August 1989, the Aqueduct was drained as an emergency response when sediment plugged the Aqueduct due to flooding along Olancha Creek. Approximately 1 week afterwards, a fish kill was reported in the Lower Owens River (Parmenter, 1989). CDFG monitored mortality near the Alabama Gates and observed moribund largemouth bass, bluegill, brown bullhead, carp, and crayfish in recently flooded grass-bottomed depressions and floating in the channel.

During the 1993 controlled flow study, substantial fish kills occurred in the river channel from Mazourka Canyon Road to just south of Keeler Bridge (Hill et al. 1998; Jackson, 1994). The fish killed included both game (largemouth and smallmouth bass, bluegill, and catfish) and non-game species (carp, suckers, chubs) (Hill et al. 1998).

The Owens River upstream of the Aqueduct Intake is also dominated by non-native game fish (C. Milliron, pers. comm., 2000). Brown trout are the dominant species in terms of numbers and mass in the upper reach of the Owens River below Pleasant Valley Reservoir, with populations as high as 7,000 fish/mile (Deinstadt and Parmenter, 1997).

Eight non-native fish species are confirmed in the Lower Owens River based on a review of the above information and discussions with fishery biologists (Table 4-12). These species include: largemouth bass *(Micropterus salmoides),* smallmouth bass *(Micropterus dolomieui),* bluegill *(Lepomis macrochirus),* carp *(Cyprinius carpio),* brown trout *(Salmo trutta),* channel catfish (*Ichtalurus punctatus),* brown bullhead *(Ictalurus nebulosus)*, and mosquitofish *(Gambusia affinis).* The chubs and suckers reported from the fish kills probably washed in from the intake and/or Aqueduct, as there are no known populations of these fish within the LORP area. The following is a summary account of the available information on occurrence, behavior, habitat preferences and relative abundance of non-native fish that occur in the wet reach of the river. A qualitative indication of their relative abundance is also given in Table 4-12.

- **Largemouth Bass.** Largemouth bass are relatively abundant throughout the river channel habitats from the Billy Lake return south to the delta. This species prefers areas with low velocities. Largemouth bass typically reach sexual maturity at 2 to 3 years and spawn from April through June. Nests are constructed in sand, gravel, and debris-littered bottoms at depths of 3 to 6 feet. The eggs and larvae remain at the nest for 7 to 13 days. The young fish feed primarily on zooplankton until they reach a length of 4 inches. Adult largemouth bass are predatory and consume fish and macroinvertebrates, particularly crayfish.

TABLE 4-12
FISH IN THE WETTED REACH OF THE RIVER AND THE OFF-RIVER LAKES AND PONDS

Species (all non-native except as noted)	Relative Abundance
Largemouth bass	H
Smallmouth bass	L
Bluegill	H
Carp	H
Brown trout	L
Channel catfish	M
Brown bullhead	M
Mosquitofish	H
Sucker* (native)	U
Chubs* (native)	U
U = Species presence and/or abundance unknown L = Species in low abundance M = Species in moderate abundance H = Species in high abundance	
* The only reference to suckers and chubs in the river is from Hill *et al.* (1998). Garcia and Associates assumes chubs were most likely Lahontan tui-chubs and not Owens tui-chubs. It is unknown what species of sucker was present. Suckers probably entered the river habitat from the spillways where they are known to occur in the Aqueduct.	

- **Smallmouth Bass**. Smallmouth bass are relatively uncommon in the river. During snorkeling surveys conducted by Ecosystem Sciences, very few individual smallmouth bass were observed in the river below the Intake (Hill et al., 1998). Current conditions (e.g., beaver ponds) in the river favor largemouth bass. Smallmouth are more of a riverine species. Smallmouth bass are predatory and consume fish and macroinvertebrates, particularly crayfish.

- **Bluegill**. This species is established throughout the river channel, including beaver ponds. Bluegill are highly opportunistic feeders, ingesting insects, snails and small fish. They have a wide physiological tolerance and can survive in shallow water with surprisingly low oxygen content (1 mg/L) and can reproduce under a wide variety of environmental conditions (Moyle, 1976). Spawning takes place throughout the spring and summer, and females are capable of producing up to 50,000 eggs, depending on size (Sigler and Sigler, 1987).

- **Carp**. This species is common throughout the watered reaches of the river within the LORP. The carp is a deep-bodied fish, usually olive-green to gold on the back, becoming yellow on the belly. The mouth has a pair of barbels on each side. Carp have a long dorsal fin and variable scaling patterns. Carp are relatively long lived, fast-growing fish. Carp are omnivorous and opportunistic feeders that primarily consume aquatic invertebrates, mostly insects. The carp spawn in spring, in water temperatures ranging from 58 to 67 F. Spawning takes place in warm, shallow, often weedy areas. The slightly adhesive eggs stick to debris or plants or occasionally sink in the bottom substrate. The spawning period may last from early May to late August. Large females (10 pounds) can lay over 100,000 eggs. Carp are adapted to a wide range of habitats including rivers, ponds and lakes. They often have a profound affect on aquatic ecology by removing macrophytes and increasing turbidity.

- **Brown trout.** This is not a common fish in the river. This species probably finds its way into the river through spillgates. Brown trout are well-established in the Owens River above the Intake (Deinstadt and Parmenter, 1997). The brown trout's back is olive to greenish brown in coloration. Rather large dark spots appear upon the back and sides but are not developed on the caudal fin. Reddish spots that have pale borders are profuse over the upper part of the body. Scott and Crossman (1973) report that brown trout eat a variety of organisms, including aquatic and terrestrial insects, crayfish, mollusks, salamanders, frogs, rodents, and fish. Brown trout spawn during the fall, typically from late October to December. Brown trout spawn in riffle areas, and the eggs are deposited in redds. Depending on size, a female lays from 200 to more than 6,000 eggs. The average age at maturity is 2 to 3 years, with males often maturing earlier than females. Factors that currently limit this species' distribution include the quality and availability of riverine habitats.

- **Channel Catfish.** Channel catfish are found throughout the LORP in low to moderate abundance. Channel catfish can be distinguished from the Brown bullhead by its long anal fin and deeply forked tail. The body is pale bluish-olive above and bluish-white below. Spots may be present over much or none of the body. Channel catfish are omnivores, consuming a wide variety of food materials, including organic debris, crayfish, snails, fish and plant material (Sigler and Sigler, 1987). Spawning takes place in spring or early summer in semi-dark nests in undercut logs and banks. Female lay as many as 34,500 eggs (Sigler and Sigler, 1987). This species has a wide tolerance for environmental conditions and can live in waters with oxygen concentrations as low as 1 to 2 mg/L and temperatures of 36-38°C (Moyle, 1976).

- **Brown Bullhead.** This species is found within the river within the LORP in low to moderate abundance. It is yellowish-brown above and heavily mottled on the sides with a yellow or, at times, white ventral surface (Sigler and Sigler, 1987). Brown bullhead reach approximately 15 inches and are omnivorous, consuming insect larvae, crustaceans, snails, crayfish and small fish (Sigler and Sigler, 1987). The brown bullhead spawns in spring in a saucer-shaped nest and deposits up to 10,000 adhesive eggs. Brown bullheads are capable of living in stagnant waters and shallow ponds and have a wide physiological tolerance (Sigler and Sigler, 1987).

- **Mosquitofish.** This fish is common throughout the river within the LORP. Mosquitofish have been stocked throughout the world for mosquito control. This species is brown to olive on top with a silvery shine, darkest on the head and back and lightest on the belly. The scales are outlined by black pigment. Females reach a larger size than males, 2.5 and 1.75 inches, respectively. Males reach sexual maturity in 4 to 6 weeks (Sigler and Sigler, 1987). Mosquitofish feed on various insects in addition to mosquito larvae. Aggressive behavior by mosquitofish has been cited as a negative factor influencing Owens pupfish populations (J. Mire, pers. comm., 2000).

4.6.2 Potential Impacts – Game and Native Fish

<u>Fish Kills due to Initial Releases (Short-Term Impacts)</u>

Based on the analysis of water quality impacts in Section 4.4.3, it was concluded that the proposed 40-cfs baseflow could cause substantial, though temporary, degradation of water quality downstream of Mazourka Canyon Road. The poor water quality could adversely affect fish due to the depletion of oxygen, and possible increase in hydrogen sulfide, and ammonia. Seasonal habitat flows of up to 200 cfs could also cause water quality degradation, possibly more than under 40 cfs flows. However, the fishery is expected to recover once water quality conditions improve.

The water quality impacts and resulting fish kill are only expected to occur along the river downstream of Mazourka Canyon Road where the organic sediments are present. The reach upstream of Mazourka Canyon Road would be available for fish to use as refugia during adverse water quality conditions. Additional refuge areas will be provided as part of the project (Sections 2.3.5.2 and 2.3.5.4) by releasing higher quality water from up to three spillgates. However, since the spillgate releases are miles apart, they will provide refuge areas to only a limited percentage of affected fishes.

The potential degradation of water quality during the initial releases represents a significant and unmitigable impact (Class I) that could cause substantial fish kills along the river downstream of Mazourka Canyon Road during the initial years of the project, until water quality conditions improve.

However, a warmwater fishery exists today, which suggests that the fishery has recovered from the fish kills in 1993. For these reasons, the lead and responsible agencies do not believe that the warmwater fishery along the Lower Owens River would be destroyed due to water quality degradation from the new flows. However, in the worst-case scenario, the fishery along the river may be subject to a substantial reduction, and it could take many years for the game fishery to recover to pre-project conditions.

To facilitate recovery if natural re-colonization does not occur after water quality conditions improve, LADWP would implement and fund a fish recovery program in cooperation with the California Department of Fish and Game, as described in Mitigation Measure F-1 (Section 4.6.3). However, since the restocking program would not mitigate the short-term impact of potential fish kills, impacts on fish populations are considered significant after incorporation of feasible mitigation. Further mitigation was considered and determined to be infeasible as discussed in Section 4.4.3.1 and below:

- Based on recommendations by the Regional Board (NOP letter dated February 24, 2000), temporary removal and restocking of fishes were evaluated as a potential mitigation measure for reducing short-term water quality impacts. However, this measure was determined to be infeasible due to the logistical constraints involved in capturing fish from 30 miles of river channel and transporting and maintaining them in healthy conditions until water quality improves. Netting, trapping, and/or electroshocking of large numbers of fishes, temporarily storing them, then recapturing them for re-release to the river would substantially stress and potentially result in large numbers of injured or dead individuals. The magnitude of any fish kill related to temporary removal is unknown, but could exceed the mortality due to water quality degradation under LORP.

<u>**Long-term Impact on Existing Fish Habitats and Populations**</u>

Fish mortality may occur during the initial period of flow introduction due to degradation of water quality conditions, specifically decreased dissolved oxygen and increased toxic substances such as ammonia and hydrogen sulfide. Fish are expected to re-colonize the river once water quality conditions improve. Fish would re-colonize from the river above Mazourka Canyon Road, the off-channel lakes and ponds, and the spillgates. The re-watering would have an overall long-term beneficial impact on the warmwater fishery by increasing its productivity (more area) and providing more diverse habitat to support less common species such as the brown trout and smallmouth bass. No new species are expected to colonize the river. In general, non-native game fish such as bluegill, bullhead, catfish, carp and largemouth bass exhibit very plastic life history strategies and a wide variety of physiological tolerances. These characteristics allow for rapid distribution into wetted reaches. Within the newly-created river reach below the Intake, brown trout and smallmouth bass may prefer the more riverine reaches. Largemouth bass and bluegill may be more successful in the impounded areas and backwaters with low velocities. **The enhancement of the existing warmwater fishery is considered a beneficial impact (Class IV).**

The potential fish responses to the long-term re-watering of the river is described below for individual reaches identified in the LORP plan are summarized below:

River Intake to Mazourka Canyon Road

This reach has a well-established channel and is expected to be characterized by riverine flow with minimal backwater slough areas. Fish colonization into the dry reach should proceed rapidly. The species composition of this reach is expected to be similar to the community of fish immediately above the intake. The fish assemblage above the Intake is the same as within the LORP area, as described above, with brown trout being the dominant species (C. Milliron, pers. comm. 2000). Water released from the intake is expected to be of high quality. Muck and other organic material have not accumulated to a great degree in this reach, compared with the reach below the Alabama Gates. The accumulated material should be relatively oxidized and not as detrimental to water as the unoxidized sediments accumulated in the currently-wetted areas located further downstream. Fish passage from above the intake would not be restricted. Owens sucker are present in the river near Big Pine (D. Sada, pers., comm. 2000). This species is expected to eventually repopulate the river within the LORP. Owens speckled dace could also find suitable habitat in this reach.

Mazourka Canyon Road to the North End of the Islands

This wetted reach is expected to be similar in character to the currently dry reach once flows have been established. The primary difference in the wetted reach is the off-channel lakes and ponds, which would provide a steady source of warmwater fish to this reach. Game fish would also be able to capitalize on the corridors between off-channel lakes and ponds. Brown trout and smallmouth bass would also colonize this reach. Owens sucker should colonize the riverine habitats within this reach.

North End of the Islands to Lone Pine Station Road

The river channel has aggraded in this reach, creating a broad flat area. The channel is essentially undefined and water braids throughout the broad flat, resulting in isolated land areas surrounded by shallow, slow water (Hill and Platts 1998). Tules may dominate channel features. Largemouth bass, bluegill, carp, catfish and mosquitofish are expected to become distributed throughout this reach. Owens dace might benefit from habitats created in the island reach. Species that prefer fast-moving water (e.g., brown trout, smallmouth bass, Owens suckers) are not expected to flourish in this reach, although they may migrate through this reach.

Lone Pine Station Road to about 2.5 miles South of Keeler Bridge

Water quality would be the slowest to recover in this reach. Water quality conditions will improve as accumulated muck and organic material are deposited on the floodplains and/or transported downstream. A very productive game fishery is anticipated in this reach. The lower impounded reach of the river would likely be dominated by largemouth bass, bluegill, bullhead, carp and catfish. As water quality conditions improve and flows stabilize, brown trout and smallmouth bass may be common in this reach. Native fish species such as Owens sucker and Owens dace may benefit from habitat created in this reach.

2.5 miles South of Keeler Bridge to the Owens River Delta

This reach is composed of a myriad of channels and shallow depressions. The Delta could provide suitable habitat for native fishes under the proposed baseflows and pulse flows. Owens pupfish and Owens tui chub are habitat indicator species for the Delta reach. Although Owens pupfish were not known historically to inhabit Owens Lake (Miller, 1973), the creation of broad, open and shallow habitat with typically high temperatures and low dissolved oxygen is suitable habitat for Owens pupfish. Pupfish should be able to occupy areas that are isolated from non-native predatory fish, similar to what has happened at Marvin's Marsh and BLM Springs. Owens tui chub would be limited by hybridization with Lahontan tui chub. Owens sucker may be limited by flow. Owens speckled dace should find suitable habitat in the channels.

Data collected during the 1993 flow study were used to determine habitat characteristics at various flow regimes. Modeling was performed using the Physical Habitat Simulation Model (PHABSIM) by Don Chapman Consultants, Inc. (1994). The model was run independently for each of the above reaches, as described above by Hill et al. (1994).

The output from the PHABSIM model is a set of response curves that depict weighted useable area based on model discharge available to fish in accordance with established habitat preference criteria for each species and life stage. The "Wetted Reach" set of response curves for weighted useable area by model discharge are considered representative of potential fish responses after the initial period of flow introduction. These curves are not significantly different from the set of "Combined Curves" provided for the entire Lower Owens River. Predicted responses of individual species to the long-term habitat improvements in the LORP are noted below.

- The weighted useable area (WUA) response curves for largemouth bass indicate that habitat for all life stages increases with flow. Although this appears to be an unusual response to flows for this species, it is likely that this species would increase throughout the river with additional flows.
- Smallmouth bass spawning and juvenile habitat will not be limited at any flow. Adult habitat is predicted to increase only marginally with flows. Fry habitat will be maximized at 8 to 15 cfs. A flow of 40 cfs optimizes adult habitat while minimizing the loss of fry habitat. Smallmouth bass are expected to become more abundant with the new flows. The optimum flow for bluegill appears to be 40 cfs for all life stages. This species is also expected to become more abundant with the new flows.
- Brown trout are likely to colonize the wetted reaches with the new flows. Although flows in the range of 80 - 100 cfs are more suited for brown trout life history stages, flows of 40 cfs would benefit this species. This species would also do well in the impounded reach above the pump station.
- Spawning, adult and juvenile carp habitat increases with increasing flows, although the weighted useable area for fry habitat at 40 cfs exhibited a negative effect. It is likely that this species would increase throughout the river with additional flows.
- All life stages of channel catfish showed a positive response to the 40-cfs baseflow, and as such, this species is expected to increase throughout the river with additional flows.
- Although there are no habitat suitability curves prepared for Owens sucker, flows of 18-25 cfs would provide optimum habitat for all life history stages of Sacramento sucker, a close relative of Owens sucker (D. Sada, pers. comm., 2000). At 40 cfs, habitat suitability for all life stages is below the optimum but is still relatively high.
- Projected suitable habitat for all life stages of speckled dace occurs at about 8 cfs and is relatively low at 40 cfs. It appears that providing 40 cfs would reduce the total productivity of Owens speckled dace. However, these curves may not reflect current knowledge of the life histories of this species (D. Sada, pers. comm. 2000).

4.6.3 Mitigation Measures

F-1 In the event that the natural re-colonization of the game fishery does not occur within 5 years after water quality conditions have improved, or appears to be occurring at a very slow rate, LADWP shall implement and fund a one-time fish-stocking program (depending on availability of fish stock from state fish hatcheries) in coordination with CDFG, in the fifth year after water quality in the river has improved. Fish stocks from sources within the Owens Valley will be used preferentially. Fish stocks from outside the valley will be used if in-valley stocks are not available. The program will be designed to initiate re-colonization and to stimulate population growth to establish game fish populations within 10 years after water quality conditions have improved.

4.7 WILDLIFE, INCLUDING SPECIAL STATUS SPECIES

4.7.1 Existing Conditions

The Owens Valley contains a rich assortment of wildlife species due to the variety of vegetation types, including both upland and wetland types, and the large expanse of open space on the valley floor. There is a particularly rich assemblage of bird species present, including residents, migrants, and summer breeders. The valley supports numerous waterfowl and shorebirds, neotropical migrants, and migrant and resident raptors. The removal of saltcedar under Inyo County's current program allows native vegetation types to become re-established and provide more habitat for native wildlife species, particularly birds.

Bird species that regularly occur in the Lower Owen River Project area are listed in Appendix D. The seasonal status, frequency of occurrence, and habitat for each species are also listed. This information was compiled by Denise LaBerteaux (of Eremico Consulting), from Garrett and Dunn (1981), and from unpublished data provided by Tom and Jo Heindel (pers. comm. with URS Corp. and ICWD). The high number of species that occur within the Lower Owens River project area reflects the importance of the area as a migration corridor, wintering grounds, and/or breeding grounds for these species.

Riparian-dependent bird species are the primary terrestrial wildlife species affected by the riverine-riparian system – i.e., the rewatering of the Lower Owens River. Several surveys have been conducted in recent years to characterize the birds that use the river and associated riparian habitats, including surveys by Layman and Williams (1994), Kirk (1995), Point Reyes Bird Observatory (1999a, 1999b), and a survey conducted by Eremico (2000) for the EIS/EIR. The latter consisted of point count censuses conducted along three stretches of the Lower Owens River to determine breeding bird abundance, species richness, and diversity during the 2000 breeding season. Point count methods followed guidelines described in Ralph et al. (1993 and 1995). These methods were used by the Point Reyes Bird Observatory for its riparian songbird monitoring program in the eastern Sierra Nevada/western Great Basin region in 1998 and 1999 (Heath and Ballard 1999a, 1999b).

The first site, located south of Keeler Bridge, was identified as ORKR. The second site was established south of Lone Pine Station Road and was identified as ORLP. The third site occurred south of Manzanar-Reward Road. This site was identified as ORMR. A total of 20 point count stations were located along each transect. The distance between each point count station was paced out and measured approximately 250 meters. This spacing helped to ensure independent samples between points.

Five-minute point counts were completed at each station along a given transect. Counting at the first station along a transect began within 30 minutes after official sunrise and continued until all points were counted. Each transect was completed within three to four hours. Stations were counted in the same sequence each time the transect was sampled to standardize the results. Each transect was surveyed three times, approximately two weeks apart. Surveys occurred between 29 May and 28 June 2000.

Analyses for relative abundance, species richness, and diversity were completed only for breeding birds detected along each transect. All nonbreeding species were excluded from the analyses. Species not properly censused by the point count method were also excluded, even though they may have bred at the sites. These species included large hawks, owls, swifts, swallows, ravens, waterfowl, shorebirds, waders, goatsuckers, dove, and quail.

The total number of breeding birds detected within 50 meters during the three census periods and the mean number of individuals per point per census are given for each site in Table 4-13. Species richness and diversity at each site are summarized in Table 4-14A. In all, 35 breeding species were detected during the censuses. Only four of the 14 species recognized as riparian focal species by the California Partners In Flight Riparian Habitat Joint Venture (RHJV, 1998) were detected -- willow flycatcher, common yellowthroat, song sparrow, and black-headed grosbeak. Both common yellowthroat and song sparrow were among the most commonly occurring species. Red-winged blackbird and brown-headed cowbird were the other two most common species detected at the point count stations. Only one willow flycatcher was detected during the first survey period at the ORMR site. This bird was probably a migrant since it was not detected during subsequent visits. It could not be determined if it was the federally listed subspecies, *extimus,* because this determination must be made in hand or by genetic analysis.

TABLE 4-13
SUMMARY OF BIRD CENSUS ALONG THE LOWER OWENS RIVER IN 2000

Site	Total Number of Individuals	Mean Number of Individuals Per Point Per Census
ORKR	600	10.02
ORLP	836	13.93
ORMR	600	10.02

TABLE 4-14A
BIRD SPECIES DIVERSITY ALONG THE LOWER OWENS RIVER IN 2000

Site	Species Richness	Mean SR Per Point	Shannon-Wiener Diversity Index $(N_1)^1$	Mean SW Per Point
ORKR	27	9.45	11.80	7.10
ORLP	30	11.65	13.41	7.68
ORMR	25	9.00	9.95	6.44

Note: Mean species richness (SR), Shannon-Wiener index of diversity and mean index of diversity (SW) for breeding species along the Lower Owens River detected within 50 m averaged over three visits in 2000. $^1N_1 = 2^{H'}$ where H' is the Shannon-Wiener Index (Krebs 1989)

The 10 riparian habitat focal species that were not detected by point counts at any site included Swainson's hawk, yellow-billed cuckoo, least Bell's vireo, warbling vireo, bank swallow, yellow warbler, yellow-breasted chat, blue grosbeak, Wilson's warbler, and Swainson's thrush. The former 8 species are potential breeders in the Lower Owens River region. However, the quality and/or quantity of habitat currently existing along this portion of the river may be insufficient in supporting breeding pairs of these species. Habitat requirements for the riparian habitat focal species are discussed by RHJV (1998). The breeding ranges of Wilson's warbler and Swainson's thrush occur at higher elevations than the Owens Valley, and hence, preclude them from breeding along the river.

Other riparian obligate species that were detected during the censuses but were not included in the analyses were red-shouldered hawk and wood duck, both documented breeders in the Owens Valley. The hawk was detected during the first period at the ORLP site. Red-shouldered hawks are considered uncommon breeders in the Owens Valley, including in the Lone Pine area (Tom and Jo Heindel, pers. comm.). Small numbers of these hawks can be found during all months in and around the town of Lone Pine, including the area of the ORLP site (A. Kirk, pers. comm.). Wood ducks were detected at the ORLP and the ORMR sites. A single wood duck flew over the riparian habitat at ORLP during the first census. At the ORMR site, a female wood duck was observed with four chicks during the third census period. Wood ducks are considered uncommon breeders in the Owens Valley (Tom and Jo Heindel, pers. comm.).

Species richness and the mean number of individuals detected per point count station were similar to those from other studies in the area. However, species diversity was on the low end of the range (Heath and Ballard 1999a, 1999b). The lower bird diversity in the Lower Owens River Project area can be attributed to the unevenness in the number of individuals of each species. The point counts from this study recorded high numbers of only a few species (e.g., red-winged blackbirds, song sparrows, common yellowthroats, and brown-headed cowbirds) and low numbers of many species. The low structural diversity in the riparian habitat along the Lower Owens River is probably the primary factor responsible for the low bird diversity in this area.

4.7.2 Potential Impacts – Wildlife, Including Special Status Species

<u>Anticipated Beneficial Impacts</u>

Rewatering the Lower Owens River is expected to increase the diversity, extent, and productivity of riparian and wetland habitats along the river. As described in Section 4.5.2, Ecosystem Sciences (1997) conducted a modeling analysis to predict the anticipated changes in vegetation types along the river due to the 40 cfs baseflow and up to 200 cfs seasonal habitat flows. Their analysis indicated a substantial conversion of habitats that would result in more open water, increased emergent wetlands, and increased willow dominated habitats.

In a related analysis, Ecosystem Sciences examined how bird species would respond to the new habitats using principles of wildlife-habitat relationships and Habitat Evaluation Procedures (HEP), a common analytic model to predict wildlife responses to habitat changes as described in Technical Memorandum and Ecosystem Sciences (1994). In the model, Ecosystem Sciences chose 15 evaluation species or guilds that reflected a wide range of habitat preferences in riparian, wetland, and open water habitats present in the valley. They include yellow warbler, willow flycatcher, yellow-billed cuckoo, marsh wren, belted kingfisher, Canada goose, western snowy plover, downy woodpecker, northern flicker, rails, waterfowl guild, waterfowl breeding guild, and shorebird guild.

Physical characteristics of existing habitats along the river and in wetlands at Blackrock and the Delta were measured in the field in 1993 and incorporated into the model. The HEP uses the predicted changes in habitat characteristics due to re-watering (i.e., habitat conversion) to determine the suitability of the new habitats for the evaluation species. Hence, an increase in woody riparian vegetation would increase vegetative structure and cover, and result in more favorable habitat for riparian breeding birds. Conversely, an increase in open water habitat due to flooding of pastures would increase the suitability of the habitat for waterfowl.

The results of the modeling were consistent with the qualitative predictions: re-watering the Lower Owens River would increase the diversity and abundance of the avifauna, including riparian dependent birds and certain water associated birds. Special status species that could benefit from the re-watering include the willow flycatcher, yellow-billed cuckoo, great blue heron, great egret, black-crowned night heron, Cooper's hawk, sharp-shinned hawk, golden eagle, ferruginous hawk, Swainson's hawk, long-eared owl, Vaux's swift, LeConte's thrasher, and loggerhead shrike.

Waterfowl and shorebirds would not benefit substantially from the river enhancements; however, habitat for these species would be enhanced and expanded at Blackrock and the Delta.

The enhanced riparian habitats along the Lower Owens River would also benefit mammals due to the increased diversity and cover of riparian vegetation.

The wildlife related goals for the Riverine-Riparian system in the MOU are to "… *create and sustain healthy and diverse riparian and aquatic habitats… through flow and land management, to the extent feasible, consistent with the needs of the "habitat indicator species."* The habitat indicator avian species for the river include various riparian dependent species and several water-associated birds: yellow warbler, willow flycatcher, yellow-breasted chat, blue grosbeak, yellow-billed cuckoo, warbling vireo, tree swallow, belted kingfisher, Nuttall's woodpecker, long-eared owl, red-shouldered hawk, Swainson's hawk, northern harrier, rails, least bittern, marsh wren, wood duck, and great blue heron.

The proposed re-watering of the Lower Owens River is anticipated to increase the extent, diversity, and productivity of riparian and wetland habitats along the river. This enhancement of habitats would be consistent with the needs of the habitat indicator species by providing specific habitat requirements that would benefit individual species.

In light of the above information and considerations, the rewatering of the Lower Owens River is anticipated to increase the extent, quality, and diversity of habitat for wildlife, particularly for birds. **This is considered a beneficial impact (Class IV).** The predicted habitat enhancements could potentially benefit both the State and Federally listed subspecies of willow flycatcher.

Effects of Increased Cattail and Bulrush Stands on Avian Diversity

The wetted reach of the river from just above Mazourka Canyon Road to the Delta is currently dominated by cattail and bulrush marsh. These plants thrive in relatively slow moving water, water depths of four to five feet, and exposure to sunlight. Ecosystem Sciences noted in Technical Memorandum 9 (no date) that the re-watering of the Lower Owens River would increase the amount of cattail and bulrush marsh. They estimated the future extent of cattail and bulrush marsh along the river based on an analysis of landforms along the river channel and water surface elevations under the 40 cfs baseflow. Ecosystem Sciences (unpublished data) predicted that the amount of emergent wetlands (e.g., cattails and bulrushes) would increase from 293 to 1,175 acres (see Table 4-11). The predicted increase in cattail and bulrush marsh would be beneficial for many riparian- and water-associated birds, which use the dense cover for shelter and nesting, such as American bitterns, least bitterns, Virginia rails, American coots, pied-billed grebes, ruddy ducks, redheads, mallards, northern pintails, and soras. Many of the habitat indicator species identified in the MOU for the river rely on this type of habitat.

Cattail and bulrush marsh is already very abundant along the Lower Owens River, and as such, is not a target habitat under the LORP. More importantly, the establishment of new and extensive cattail and bulrush marsh could hinder progress towards creating more diversity of riparian and wetland habitats. In particular, the development of large and vigorous stands could reduce open water habitats needed by waterfowl.

The proposed LORP management approach for future cattail and bulrush marsh is to encourage riparian trees to develop along the margins of the river channel to shade the cattails and bulrushes. In addition, there has been an assumption that the seasonal habitat flows would scour the cattail and bulrush stands. However, flows in the river are not expected to scour cattails and bulrushes. Ecosystem Sciences (Technical Memorandum No. 9, no date) referenced a study on the hydrodynamic control of cattails and bulrushes (Groeneveld, 1994), which predicted whether certain flows would dislodge cattail and bulrush stems and prevent the establishment of an emergent marsh. Results of the HEC-2 modeling by Don Chapman Consultants (1993) for the Lower Owens River indicated that average velocities for both the 40 cfs baseflows and the 200 cfs seasonal habitat flows would not exceed the velocity needed to dislodge stems. However, observations of flow velocities at the Mazourka Canyon Road station during the 1993 field experiment were greater than 1 fps under both baseflow conditions, and when the discharge from the River Intake was 155 cfs (Jackson, 1994). Hence, there is potential for some scouring of tules with the proposed flow regime, based on the available data.

Based on the above considerations, there is potential for cattail and bulrush plants to invade newly flooded areas. A proliferation of emergent marsh habitat would benefit many water-associated birds, but could also decrease the diversity of riparian habitats and reduce open water habitat.

Extensive removal or active management of tule stands to control tule growth or to increase open water habitat (i.e., for habitat purposes) is not a part of the LORP and is not addressed in this EIR/EIS. In the future, such extensive measures would only be considered if it was determined that the benefits outweighed the adverse environmental effects, and only if funding for such work was obtained from sources other than LADWP or the County. Because extensive removal of tules could result in significant adverse impacts, such measures would be subject to a separate CEQA and NEPA review as required by law.

The proposed monitoring and adaptive management program (see Section 2.10) includes provisions to address the proliferation of emergent marsh habitat. Under the LORP, active cattail and bulrush removal would only be considered in rare instances and of limited extent, and would probably only be considered where there are significant constrictions along the river or at culverts. **Consequently, there is a potential for the amount of cattail and bulrush marsh to proliferate at the expense of open water habitat, which would be considered an adverse but not significant impact (Class III).**

Removal of cattails and bulrushes, if it is undertaken, could cause several incidental impacts depending upon the time of year, amount removed, and the method of removal. Cattails and bulrushes are used for nesting by various bird species and one special status species – least bittern. Mechanical removal of tules during the spring and early summer could disturb nesting birds by destroying cover and nests, altering breeding behavior, and displacing breeding pairs. **This impact is considered significant, but mitigable (Class II).** This impact can be avoided by scheduling the removal for the fall and winter months, as described below in Section 4.7.3 (Measure RW-1).

Mechanical removal of cattail and bulrush stands would require access routes to the wetted channel for equipment, staging areas for truck and equipment maneuvering, and a temporary dewatering site. Establishment of these temporary work areas could disturb wetland and riparian vegetation. The amount of habitat that would be affected at any single work area is expected to be less than 5,000 square feet, and the frequency of marsh removal operations is expected to be rare. In addition, the habitats that would be disturbed (e.g., alkali meadow, willow scrub) are expected to recover quickly through natural recovery processes. **In light of this information, the temporary disturbance to riparian habitats during limited tule removal is considered an adverse, but not significant impact (Class III).** Best management practices to reduce the magnitude of the impact and facilitate post-work recovery are provided in Section 4.7.3 (Measure RW-2).

Mechanical removal of cattail and bulrush stands would involve the use of a Gradall™ or clamshell bucket working in the wetted channel. The physical excavation of the vegetation, including the root mass, would cause increased turbidity and suspended sediments at and downstream of the work areas. Water quality impacts are described in Section 4.1.3.

Beaver Dam Removal

Beaver dams will continue to be removed on an as-needed basis during the LORP, utilizing the methods of the existing program (described in Section 2.3.7), but also including the reach of the river up to the River Intake.

4.7.3 Mitigation Measures

RW-1 If necessary to remove limited cattail and bulrush obstructions, mechanical removal of cattail and bulrush stands shall only occur in the fall and winter (October 1 to March 1) to avoid conflicts with breeding birds. Work outside of this time may be conducted if field surveys determine there would be no effect to nesting birds.

RW-2 Impacts to wetland and riparian habitats adjacent to the work area shall be minimized by making use of existing barren areas for staging, operations, and stockpiling; crushing vegetation in the work area rather than clearing or grading it; and mulching areas denuded during operations with vegetative debris to encourage natural revegetation and discourage noxious weeds.

4.8 CULTURAL RESOURCES

The consultations with Native American Tribes and the cultural resources inventories completed for the LORP are described below. Three separate field investigations were completed to investigate cultural resources – one in 2000, a second in 2003, and a third in 2004. The second investigation was necessary since channel clearing work was not identified as part of the project until after the first cultural resources inventory in 2000. The third investigation was necessary to evaluate the historic significance of rock dams, old bridge abutments, and other structural obstacles that will be removed from the river channel prior to initial flow releases. Impact assessment for cultural resources is presented in the EIR by geographic area of the LORP - Section 4.8.4 for the Riverine-Riparian System, Section 5.4 for the pump station site and power line corridor, and Section 7.3 for Blackrock Waterfowl Habitat Area. Section 14.9 describes the relationship of the project to the National Historic Preservation Act (NHPA).

Appendix F contains background information on prehistory and history of the LORP area as summarized from a 2001 report by Far Western Anthropological Research Group, Inc. (the cultural resources consultants for LORP), including descriptions of prehistoric and historic uses of the river and other natural resources of the Owens Valley.

4.8.1 Confidentiality of Cultural Resources Information

The EIR/EIS does not provide precise locational information on cultural resources, as it is considered sensitive and confidential. The cultural resources technical reports prepared for the project by Far Western (Far Western, 2001 and 2003; and JRP, 2004) are on file with LADWP and EPA. EPA has provided copies of the two reports to chairpersons and other representatives (e.g., cultural resources staff) of each Native American Tribe in the region (see Section 4.8.2). All copies of the reports that EPA provided were marked “confidential.” LADWP will limit its distribution of the technical reports and other technical cultural resources information related to LORP to qualified professionals contracted by LADWP. It should be noted, however, that the technical reports are available to all qualified archaeological professionals through the California Historical Resources Information System (CHRIS), which is administered by the California Office of Historic Preservation (OHP). LADWP does not have control of the distribution of cultural resources technical information through CHRIS.

4.8.2 Native American Consultation

On January 14, 2000, LADWP sent a Notice of Preparation (NOP) of a Draft EIR/EIS to the following Indian Tribal offices: Big Pine Paiute Tribe; Bishop Indian Tribal Council; Bishop Paiute Tribe; Fort Independence Indian Reservation; Fort Independence Tribal Office; Independence Paiute Tribe; Lone Pine Paiute-Shoshone Tribe; and Utu Utu Gwaitu Paiute Tribe. Written responses were received February 22, 2000, from Vernon J. Miller, Tribal Chairman for the Fort Independence Indian Reservation, and Mel O. Joseph, Environmental Coordinator for the Lone Pine Paiute-Shoshone Reservation. Both letters expressed concern about the cultural and archaeological impacts of the project. The NOP was also later sent to the Bridgeport Indian Colony and the Timbi-sha Shoshone Tribe, and the Owens Valley Indian Water Commission.

On June 15, 2000, EPA, as federal lead agency for the project, sent follow-up letters to all of the above noted Tribes detailing the Area of Potential Effect (APE, or field survey area, see Section 4.8.3.1 for definition) for cultural resources and Far Western's plans for survey of the initial APE as part of the first cultural resources inventory conducted in 2000. This letter invited Tribes to participate in the NHPA Section 106 process as consulting parties. Follow-up letters and telephone calls were made through October 2000. The 2000 cultural resources inventory has been distributed to the appropriate Tribal representatives for review and comment.

Additional Tribal consultation was conducted by EPA in 2002 and 2003 for the channel clearing work, because this activity was not identified as part of the LORP project description until after the first consultation in 2000. This consultation included an initial contact letter (dated September 10, 2002), describing the additional APE for the channel clearing work and project description, sent to eight regional Tribal groups. This was followed by phone contacts and meetings with representatives of both the Big Pine Paiute Tribe and the Lone Pine Paiute-Shoshone Reservation, who had requested additional information about the cultural resources inventory and LORP in general. The meetings took place in December 2002 at the Tribal offices. Tribal representatives were concerned about the potential for disturbance to cultural resources during the channel clearing work. No specific references or concerns with regard to Traditional Cultural Properties near or within the APE were raised. In addition to the Tribal consultations, a Tribal cultural resource specialist from the Big Pine Paiute Tribe accompanied the field survey crew during the entire inventory. The specialist independently reported his findings to the Tribal Environmental Director. The draft 2003 cultural resources inventory was provided to all Tribes in the region, and comments were requested. EPA followed up with phone solicitations for comments from the Tribal representatives who had formerly expressed interest. No comments on the 2003 cultural resources inventory were received.

Following the publication of the Draft EIR/EIS in November 2002, written comments were received from the following Tribes and Tribal representatives: Big Pine Paiute Tribe of the Owens Valley, Fort Independence Indian Reservation, Lone Pine Paiute-Shoshone Reservation, Lone Pine Paiute-Shoshone Reservation, and the Owens Valley Indian Water Commission. Oral comments from the Tribes were received from representatives of the Lone Pine Paiute-Shoshone Tribe and the Owens Valley Indian Water Commission.

4.8.3 Cultural Resources Inventories

Three evaluations of cultural resources in the project area (the initial investigation, one focused on the channel clearing work, and one focused on structural obstacles that will be removed from the river channel) were conducted by Far Western with the assistance of JRP Historical Consulting Services (JRP).

The first two evaluations were Class III cultural resources inventories which included: reviews of available literature and records, pedestrian surveys of the APE (see below for definition), National Register of Historic Places (NRHP) site evaluations, and recommendations of management actions for those sites deemed either unevaluated or eligible to the NRHP. The results of the evaluations are presented in two cultural resources technical reports completed by Far Western (2001 and 2003). The reports follow the general guidelines set forth by OHP for archaeological resource management reports (1989), and the cultural resources inventory general guidelines developed by BLM (1989).

The third evaluation was conducted to evaluate the historic significance of 16 manmade structures that are located in or adjacent to the river channel and were identified by LADWP and Ecosystem Sciences (2003) for potential removal or modification prior to initial flow releases. The evaluation included: reviews of available literature and records, a field survey of the structures, and NRHP site evaluations. The results of the evaluation are presented in a report completed by JRP (2004).

4.8.3.1 Area of Potential Effect

An area of potential effect (APE) is defined under Section 106 of the NHPA as the geographic area or areas within which an undertaking (i.e., a project activity) may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. (Historic properties include prehistoric or historic districts, sites, buildings, structures, or objects). As a result of consultations with the OHP and Far Western, EPA, as the federal lead agency for the project, determined the APE for LORP to be areas that are subject to identifiable land disturbances by construction activities proposed under LORP. The specific areas that comprise the APE (i.e., survey areas) for LORP are described below in Sections 4.8.3.2 and 4.8.3.3 and summarized in Tables 4-14B and 4-14C.

As a result of APE consultations between the EPA and OHP, areas to be affected under LORP by new river flows or flooding alone were not included in the APE, as they are not expected to create adverse impacts to existing cultural resources (see Section 4.8.4.4).

4.8.3.2 2000 Cultural Resources Inventory

Records Search. Prior to commencement of field work, a records and literature search was conducted at CHRIS Eastern Information Center (EIC), located at the University of California, Riverside, to locate any previously recorded sites in the entire LORP area. The purpose of the records search is to obtain background and contextual information on cultural resources in the general project area to facilitate the field surveys and subsequent evaluations. The following sources were also consulted: NRHP Index; OHP Archaeological Determinations of Eligibility; OHP Directory of Properties in the Historic Property Data file; (1951) USGS Independence 15’, (1951) Keeler 15’, (1958) Lone Pine 15’, and (1956) Olancha 15’ topographic maps; and archaeological site records and reports on file at CHRIS EIC.

The records search identified 12 historic sites, 157 prehistoric sites, 6 multi-component sites, 15 isolates, and 2 historic properties within the LORP vicinity along the Owens River corridor. Of the prehistoric sites, 44 were situated along the Highway 395 corridor and 43 were located at a distance greater than 1,000 feet from the Owens River. A total of 70 prehistoric sites, or nearly half, were located within 1,000 feet of the Owens River, most situated on terraces or steep banks above the river. Of all of these previously recorded sites, only one, a prehistoric site, is located within the APE. Located in the area of the proposed power transmission line, this site was subsequently re-recorded and further evaluated during the field survey (see Section 5.4.2).

Definition of APE. In consultation with OHP, the APE (the area for which field surveys were conducted) for the 2000 inventory was determined to be the following: the 30-acre construction zone for the pump station and diversion, a 200-foot wide corridor along 7.5 miles of power line, and a 50-foot wide corridor for 3.75 miles of new berms in the Blackrock Waterfowl Habitat Area, construction of several new or modified spillgates and other flow control structures in Blackrock, and 1.5 miles of new or enlarged ditches in Blackrock. OHP consultation resulted in a consensus that installation of new fences, involving only pole placement, would have negligible impacts on cultural resource sites and would be impractical to survey.

Field Survey Results. Fieldwork was conducted in June 2000 by Wendy Nelson, Ph.D., Far Western, and Rand Herbert, M.A.T., JRP. A permit for the survey was requested and received from BLM for sections of the proposed power line within BLM lands. Field investigations were carried out by a four-person team. The survey was conducted within the project APE described above. Wayne Hopper, Engineering Assistant for the Los Angeles Aqueduct Division of LADWP, accompanied the survey crew on June 22, 2000, acting as a guide in the southern portion of the Blackrock Waterfowl Habitat Area, where maps were inadequate.

Findings from the field surveys during the 2000 Cultural Resources Inventory are summarized in Table 4-14B. In total, six prehistoric sites, four historic sites, three isolated finds, and five historic structures were identified within the initial 2000 APE (Far Western, 2001). Four of the sites are on BLM land, four are located on land owned by LADWP, and the remaining two are held by the State Lands Commission. One of these sites, the River Intake historic structure, is within the Riverine-Riparian System and is discussed below (Section 4.8.4.1). Impact assessments for the other sites are presented in Sections 5.4 and 7.3.

TABLE 4-14B
SUMMARY OF FIELD SURVEY FINDINGS FROM THE 2000 CULTURAL RESOURCES INVENTORY

EIR/EIS Section	Areas Surveyed (APE)	Survey Findings (NRHP* Status)
4.8.4.1	• River Intake Structure	1 historic structure (eligible)
5.4.1	• 30-acre construction zone for the proposed pump station and diversion	2 isolates (ineligible)
5.4.2	• 200-foot wide corridor along 7.5 miles of the proposed power transmission line	1 isolate (ineligible) 4 prehistoric sites (ineligible) 4 historic sites (ineligible)
7.3.1 7.3.2	• 50-foot wide corridor for 3.75 miles of new berms in Blackrock • Spillgates and other flow control structures to be newly constructed or modified in Blackrock • 1.5 miles of new or enlarged ditches in Blackrock	2 prehistoric sites (unevaluated) 4 historic structures (ineligible)

Source: Far Western, 2001.
* Authorized under the National Historic Preservation Act of 1966, the NRHP is the Nation's official list of cultural resources worthy of preservation. Properties listed in the Register include districts, sites, buildings, structures, and objects that are significant in American history (including prehistory), architecture, archeology, engineering, and culture.

4.8.3.3 2003 Cultural Resources Inventory

Records Search. Prior to commencement of fieldwork, a records and literature search was conducted at CHRIS EIC to locate any previously recorded sites in the general area of the channel clearing work. The purpose of the records search is to obtain background and contextual information on cultural resources in the general project area to facilitate the field surveys and subsequent evaluations. The following sources were consulted: the NRHP index, OHP Archaeological Determinations of Eligibility, OHP Directory of Properties in the Historic Property Data file, (1982) USGS Blackrock 15' topographic map, and archaeological site records and reports on file at CHRIS EIC.

The records search identified seven previously recorded cultural resources sites in the search area (within 0.5 mile radius of the APE). Only one of the previously recorded resources, a historic site, was located within the APE. Another previously recorded historic site was located immediately adjacent to the APE. These two sites were subsequently re-recorded and further evaluated during the field survey of the APE (see Section 4.8.4.2).

Definition of APE. In consultation with OHP, the APE for the channel clearing work was determined to be the following: 150-foot wide corridor along the channel/bank margin (as measured from the centerline of the channel) for a 2.2-mile reach of the river downstream of the River Intake; 35-foot wide corridor along the four temporary access roads (Figure 2-2); and the 9-acre sediment stockpile area west of the River Intake. The bottom of the channel was not included in the APE since this area has a very low probability of containing intact cultural resources. The bottoms of river channels are high-energy hydrological environments not conducive to the formation of intact archaeological deposits. Furthermore, the sediments to be removed as a part of the channel clearing work are largely overgrown with tules and consist of materials that have been deposited in the last 90 years (i.e., after the River Intake structure was constructed in 1913). While isolated artifacts might be recovered, they would have been transported and deposited by alluvial processes and thus would not be in their primary archaeological context. Such resources would have little information value or significance (i.e., these resource would be ineligible to the NRHP).

Field Survey Results. Fieldwork for the APE for the channel clearing work was conducted in February 2003 by Kelly McGuire, M.A., and Wendy Nelson, Ph.D., from Far Western. As noted in Section 4.8.2, a Tribal cultural resource specialist from the Big Pine Paiute Tribe accompanied the field survey crew during the entire inventory.

Findings from the field survey in 2003 are described below (Section 4.8.4.2) and summarized in Table 4-14C. In total, three prehistoric sites, five historic sites, and five isolates were identified within or immediately adjacent to the APE for the channel clearing work.

TABLE 4-14C
SUMMARY OF FIELD SURVEY FINDINGS FROM THE 2003 CULTURAL RESOURCES INVENTORY

EIR/EIS Section	Areas Surveyed (APE)	Survey Findings (NRHP Status)
4.8.4.2	• 150-foot wide corridor along 2.2-mile reach of the Lower Owens River downstream of the River Intake • 35-foot wide corridor along the four temporary access roads (Figure 2-2) • 9-acre sediment stockpile area west of the River Intake	5 isolates (ineligible) 3 prehistoric sites (2 ineligible and 1 unevaluated*) 5 historic sites (2 ineligible, 2 unevaluated, and 1 eligible*)

Source: Far Western, 2003.
* One prehistoric site (unevaluated) and one historic site (previously recommended eligible) are located outside but immediately adjacent to the APE.

4.8.3.4 2004 Historic Resources Report

As described in Section 2.3.6, several structural obstacles to flow will be removed from the river channel prior to the commencement of releases for the Phase 1 baseflows. In 2004, JRP conducted a historic resources evaluation of 16 manmade structures (see Table 4-14D) that are located in or adjacent to the river channel and were identified by LADWP and Ecosystem Sciences (2003) as potential obstacles to flow. The evaluation included: a field survey of the structures; a review of historical mapping; interviews with LADWP and Inyo County Roads Department personnel; and additional research at the LADWP field office and the California Department of Fish and Game office in Bishop, the Eastern Sierra Museum and Inyo County Roads Department in Independence, and at the California State Library and Bureau of Land Management office in Sacramento.

Findings from the 2004 historic resources evaluation are described below (Section 4.8.4.3) and summarized in Table 4-14D.

TABLE 4-14D
SUMMARY OF FINDINGS FROM THE 2004 HISTORIC RESOURCES EVALUATION

EIR/EIS Section	Reference Number	Resource Name	Construction Date	NRHP Status	Description
4.8.4.3	2	Railroad Flatcar Bridge	unknown	Modern	Removable railroad flatcar bridge
	3	Cable Bridge	1969	Modern	Former LADWP gauging structure
	4	Bridge Berm and Culverts	Circa Early 1900s	Not eligible	Bridge berm and culverts
	5	Eastside Canal Diversion Dam	Circa late 1880s	Not eligible	Diversion dam
	6	Stevens Canal Diversion Dam	Circa 1890s-1900s	Not eligible	Diversion dam
	7	Power Line Road Culverts	Circa 1950s	Not eligible	Five culverts
	8	Mazourka Canyon Road Culverts	1969	Modern	Two culverts in channel
	9	Bridge Foundation	Circa 1900	Not eligible	Bridge abutments and pier wall
	10	Eclipse Ditch Diversion Dam	Circa 1860s	Not eligible	Diversion dam
	11	Earthen Dike	Circa 1950s-1960s	Not eligible	Earthen dike or levee
	12	Manzanar Reward Road Culverts	Circa 1969	Modern	Two culverts in channel
	13	Mojave-Owenyo Railroad Bridge	1910	Not eligible	Railroad bridge abutments and pier wall
	14	Lone Pine Narrow Gauge Road Culverts	Circa 1969	Modern	Two culverts in channel
	15	Keeler Road Bridge Abutment	Circa 1900	Not eligible	Bridge abutment and LADWP
	16	Keeler Road Bridge	1986	Modern	Concrete bridge
	17	Access Road Crossing	2001	Modern	Access road crossing on berm

Source: JRP, 2004.

4.8.4 Impacts to the Riverine-Riparian System

Impact assessment for cultural resources in the Riverine-Riparian System (the River Intake, the area of channel clearing, and areas subject to proposed flows) is presented below.

4.8.4.1 River Intake

The River Intake is part of the construction of the original phase of development of the Los Angeles Aqueduct system. It was completed in 1913, and controls flows to the Owens River by blocking the river from entering the natural channel of the Owens River and forcing it to flow west and south into the

Aqueduct Intake. Operation of the radial gates and floodbays allows the river to flow through the River Intake into the natural channel.

The River Intake has very good integrity for its period of significance (1913). It has suffered only two minor losses of integrity – the removal of the lift mechanism for one radial gate, and a slight alteration through the installation of a modern pipe railing at its eastern end in 1999. Otherwise it has good integrity of setting (which is little changed from 1913), design (it is in essentially its original condition and configuration), materials (original except for the previously-mentioned modern pipe railing), workmanship (original), feeling (original), and association (original).

The River Intake appears to meet the criteria for listing in the NRHP under Criteria A and C. The River Intake appears to meet the requirements for listing under Criterion A, as a site that is "associated with events that have made a significant contribution to the broad patterns of our history." The River Intake is associated with the development of the Los Angeles Aqueduct, and the augmentation of urban water supplies for the City of Los Angeles. The exploitation of the Owens River by the City of Los Angeles is one of the most famous examples in our nation's history of the early use of a distant water supply by an urban area. While there were some earlier examples, such as those of Boston and New York, none has assumed such a storied place in our national history.

The River Intake also appears to meet the requirements for listing under Criterion C, as a resource that embodies "the distinctive characteristics of a type, period, or method of construction." A measure of the significance of the overall system of which the River Intake is a part is indicated by the fact that its construction has been heralded in the engineering community as a work magnificent in scope and engineering. The American Society of Civil Engineers dedicated the entire original system as a National Historic Civil Engineering Landmark, noting:

> *Unprecedented in size and scope at the time of completion, this aqueduct system was the prototype for the extensive water supply systems needed to support the major urban complexes of today. Begun in 1907, this aqueduct is 232 miles (373 km) long and provides Los Angeles with a flow of 440 cubic feet per second (12.5 cubic meters per second) and generates hydroelectric power in the process* (ASCE, 2000).

While numerous reports have been written on various segments of the Los Angeles Aqueduct detailing the eligibility or lack thereof of each segment, there has been no systematic evaluation of the Aqueduct as a whole. In 1992, Julia Costello and Judith Marvin prepared a Supplemental Archaeological Survey Report for the Highway 395, Alabama Gates Four Lane Project in Inyo County. While they evaluated only the Alabama Gates and their vicinity, they suggested that the Los Angeles Aqueduct system as a whole appears to be eligible for listing in the NRHP under Criteria A and C, because it is associated with events that have made a significant contribution to the broad historical patterns and because it represents a remarkable engineering feat. In their report, Costello and Marvin (1992) recorded the Aqueduct as an archaeological site, rather than as a structure. They observed:

> *The LA Aqueduct appears to be significant for its role in the history of Owens Valley and the development of Los Angeles, and for its unique historical associations with the economics and politics of Western water issues. It is also significant for its impressive physical conveyance of virtually an entire river system through a mountain range to a city 200 miles away* (Costello and Marvin, 1992:42).

Furthermore, they stated that the Aqueduct segment within the area of their own study, extending from the Alabama Gates south for about 1 mile, "exhibits good integrity of location, setting and design, and a fair feeling of original material and workmanship," during its period of significance from the beginning of construction in 1907 to the completion of the final extension of the Aqueduct north into Mono County in 1940. Additionally, in their analysis other sites such as construction camps, maintenance roads and pump sites located along the Aqueduct also carried the potential for grouping as resources with the Aqueduct system. Costello and Marvin noted that the Alabama Gates were the largest of a total of 13 such structures along the Owens Valley portion of the Aqueduct; their list of other, smaller gates included the River Intake.

To allow for the new flow regimes proposed under LORP, the radial gate at the east end of the structure would be replaced with a new, automated metal gate. Installation would primarily involve securing and sealing the new gate to a new concrete spillway channel. The existing concrete spillway walls and upper wooden walkway would remain intact. A new 300-foot long concrete spillway channel will extend downstream from the modified gate to protect the metering station from vegetative overgrowth and excessive scouring during high flow conditions.

JRP assessed the significance of the proposed modifications to the River Intake using the criteria under the NHPA for historic properties. The results of the assessment by JRP are presented in the "Finding of No Adverse Effect" (JRP, 2001). JRP (2001) concluded that the proposed modifications would not alter the characteristics of the structure that qualify the River Intake for inclusion in the NRHP. The proposed modifications would not alter the historic integrity of location, design, materials, workmanship, feeling and association because the modification would be minimal. The proposed modifications do not involve any demolition and are all reversible. JRP (2001) also assessed whether the proposed modifications could be defined as a "substantial adverse change" as defined under the CEQA Guidelines. "Substantial adverse change" includes demolition, destruction, relocation, and alteration of a historic structure such that its significance would be impaired. JRP (2001) concluded that the proposed modifications would not significantly alter the significance or integrity of the structure, and as such, would not cause a significant impact under CEQA. **Therefore, project impacts on the River Intake are considered a less than significant impact (Class III).**

4.8.4.2 Channel Clearing

As described in Section 2.3.6, the channel clearing work involves mechanical removal of channel obstructions such as sediments and tules from a portion of the Lower Owens River channel below the River Intake prior to the initial flow releases under LORP. This channel clearing work will require the following: mechanical removal of sediment and other debris from 2.2 miles of the Lower Owens River channel downstream of the River Intake; disposal of the removed materials at a 9-acre sediment stockpile area (west of the River Intake); and construction of temporary access roads (one on the western bank along the reach of the channel to be cleared and four additional roads to provide access to the river from nearby existing service roads (Figure 2-2)). To the extent feasible, these roads would be formed by traveling over existing vegetation. However, minor clearing and grading may be required.

As summarized in Table 4-14C, a total of three prehistoric sites, five historic sites, and five isolates were identified within or immediately adjacent to the APE for the channel clearing work. Two of the prehistoric sites, two of the historic sites, and all five isolates are recommended not eligible for the NRHP. The two prehistoric sites are not considered eligible because they consist of artifact scatters with little potential for intact subsurface deposits and information they contain would not contribute to regional research issues for Owens Valley prehistory. The two historic sites are not considered eligible because they consist of small ephemeral trash accumulations, which have little research value. The five isolates are not considered eligible. No further management actions are required for these resources.

Three historic sites and one prehistoric site are either unevaluated or potentially eligible for inclusion on the NRHP. One historic site (No. 3 in Table 4-14D) is a suspension-style footbridge that crosses the channel. The channel clearing work can be accomplished without disturbing this footbridge; therefore, no impact would occur on this site. The remaining two historic sites (one unevaluated and one eligible) are previously recorded sites located near one of the proposed temporary access roads. The prehistoric site (unevaluated) is located adjacent to the sediment stockpile area. These three sites could be disturbed by establishment of the access roads and/or use of construction equipment during the channel clearing work. **This impact is considered potentially significant, but mitigable (Class II).** Significant impacts can be avoided by implementing Mitigation Measure CRR-1, which includes locating the temporary access roads around the sites and installing temporary protective fencing to prevent inadvertent disturbances from heavy equipment or sediment spoil from intruding onto the sites.

4.8.4.3 Removal of Obstacles to Flow

As described in Section 2.3.6, several structural obstacles to flow will be removed from the river channel prior to the commencement of releases for the Phase 1 baseflows. Of the 16 structures that were evaluated by JRP (2004), up to 11 may be removed or modified prior to initial flow releases (Nos. 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 14). No modifications are proposed for the remaining five structures at this time (Nos. 3, 13, 15, 16, and 17).

As summarized in Table 4-14D, none of the 16 resources is considered significant, or eligible for inclusion on the NRHP. Seven of the 16 structures were found to be of modern construction (i.e., less than 50 years old). A resource must be at least 50 years old in order to be eligible to the NRHP unless it meets specific and exacting criteria for special significance. Since these seven modern structures did not appear to meet the criteria of special significance for recently-built resources, they were not evaluated in detail with respect to their eligibility for the NRHP.

The remaining 9 structures that appear to be more than 50 years old were evaluated further for their eligibility for the NRHP. None of the resources were found to be significant within the historic contexts of irrigation and transportation (under Criterion A of the NRHP historical significance criteria), by association with important historic persons (Criterion B), in terms of construction technique or engineering (Criterion C), or as a source of information important to history (Criterion D). In addition, none of the resources retain a sufficient amount of integrity to merit listing in either NRHP or the California Register of Historical Resources. Therefore, **removal and modification of these structures would represent a less than significant impact (Class III)**.

4.8.4.4 Potential for Disturbance of Archaeological Sites from Proposed Flows

As described in Section 4.8.3.1, consultations between EPA and OHP resulted in a consensus that under LORP, areas of new river flows or flooding alone are not expected to create adverse impacts to existing cultural resources and therefore would not be included in the APE (areas to be surveyed). As described in Section 4.3.2, the width of the wetted reach of the river is expected to increase by at most 40 feet under proposed flow releases. Proposed new flows in the river and the Delta would be similar to and would certainly not exceed those experienced under natural (i.e., with no diversions from the Lower Owens River to the Aqueduct) flood conditions. No prehistoric or archaeological sites are known to occur along the margins of the Lower Owens River within the floodplain that would be affected by the baseflows and seasonal habitat flows (Far Western, 2001). Similarly, the Blackrock Waterfowl Habitat Area has been inundated repeatedly since the 1960s, and the proposed discharges under LORP to Blackrock will be low velocity. Hence, potential changes in landform over time due to the additional flows are not expected to damage or expose any archaeological sites. However, there is a remote possibility that unknown archaeological sites or cultural deposits could be affected by the new flows. **While this impact is not expected to occur, it is considered a potentially significant, but mitigable impact (Class II)**. It can be mitigated by reporting unexpected finds to a qualified archaeologist for further investigation and implementation of management actions to protect the resource, as described in Measure CRR-2.

4.8.5 Mitigation Measures

CRR-1 LADWP shall implement the following management actions to avoid impacts on cultural resources during the channel clearing work:

- LADWP shall work with a qualified archaeologist to locate the temporary access road for the channel clearing work to avoid the two historic sites identified in the field survey by Far Western (2003).
- Temporary construction fencing shall be installed along the perimeter of the area where these two historic sites are located to avoid construction equipment, vehicles, or personnel from accidentally entering and disturbing the site.
- Temporary construction fencing shall be installed between the sediment stockpile area and the adjacent prehistoric site to avoid heavy equipment and or sediment spoil from accidentally entering and disturbing the site.
- Installation of temporary fencing referenced above shall be conducted under the supervision of a qualified archaeologist.
- LADWP shall notify representatives of regional Native American Tribes prior to beginning earthwork for the channel clearing work. Interested Tribal representatives shall be invited to be present (on a volunteer basis) during earthwork.
- In the event that previously unknown prehistoric or historic cultural material is encountered, a qualified archaeologist will be contacted and will investigate the find and determine if it represents an intact deposit or archaeological site. LADWP shall implement the recommendations of the archaeologist concerning measures to protect or salvage the site. If prehistoric cultural material, LADWP shall coordinate the investigations and actions to be taken with appropriate Native American parties.

CRR-2 In the event that previously unknown prehistoric or historic cultural material is observed in areas subject to LORP-related flows or earthwork, LADWP shall retain a qualified archaeologist to investigate the find and determine if it represents an intact deposit or archaeological site. LADWP shall implement the recommendations of the archaeologist concerning measures to protect or salvage the site. If prehistoric cultural material is identified by the archaeologist, LADWP shall coordinate these investigations and actions to be taken with appropriate Native American parties. If any investigations are conducted, interested Tribal representatives would be invited to participate (on a volunteer basis).

4.9 AIR QUALITY

Emissions from Channel Clearing

As described in Section 2.3.6, LADWP will need to clear vegetation and sediments from the river channel immediately downstream of the River Intake prior to making releases. LADWP will mechanically remove sediments and marsh vegetation obstructions from 10,800 feet of the river channel. Desilting work will occur using a tracked excavator. Excavated material will be placed directly into dump trucks, and then hauled to a permanent sediment stockpile area adjacent to the River Intake. A temporary haul road will be established on the top of the west bank for the excavator and trucks. Several temporary roads will be created perpendicular to the main haul road to provide access to an existing dirt road along the Aqueduct. These roads will be restored to pre-construction grade and revegetated.

The channel clearing operations will require about four months to complete. Approximately six trucks will be used in the operation (four 4-cubic yard trucks and two 8-cubic yard trucks). The amount of material removed and hauled will range from 192 to 288 cubic yards per day, requiring about 32 to 48 truck round trips per day. Work is expected to begin in fall of 2004 or winter of 2005..

An estimate of the combined daily and total emissions from the channel clearing is provided below in Table 4-15. **Emissions from channel clearing are considered adverse, but not significant impacts (Class III).** The emissions contribute to degradation of air quality conditions in the valley, but are unlikely to cause air quality violations. The primary impact of concern is emissions of fugitive dust due to the PM10 non-attainment status for the region. Fugitive dust emissions can be reduced by the application of dust control measures (see Mitigation Measure AQ-1 in Section 5.3.3). A more detailed description of all construction related emissions from the LORP is provided in Section 5.3.

TABLE 4-15
ESTIMATED EMISSIONS FROM CHANNEL CLEARING *

Activity	Carbon Monoxide	Reactive Organic Gases (hydrocarbons)	Nitrogen Oxides	Particulate Matter (PM10)
Maximum Daily Emissions (lbs per day)				
Initial channel clearing	1.1	0.5	15	1.3
Total Construction Emissions (tons)				
Initial channel clearing	0.1	0.2	0.4	<0.1

*Emissions calculated by URS Corporation for the EIR/EIS.

Release of Gases During Initial Rewatering

The initial rewatering of the river will cause a short-term adverse water quality impact that could result in objectionable odors from off-gassing of the organic sediments. Hydrogen sulfide and methane could be released. People that are located adjacent to the river during the initial releases could be exposed to these gases, which could be unpleasant. Individuals that are on the river banks could be exposed to high concentrations that could cause respiratory distress. The magnitude of this impact is expected to be very low because few people reside adjacent to the river, or will be present along the river during the initial rewatering. If LADWP and the County become aware that hydrogen sulfide and/or methane is arising from the river, efforts to warn people who may visit the river of the situation (i.e., the posting of warning signs and/or notification of media) will be undertaken by LADWP and the County. Hence, **the potential exposure to objectionable gasses and odors during the initial rewatering is considered an adverse but not significant impact (Class III).**