CHAPTER III

Affected Environment and Environmental Consequences

Chapter III

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter presents the general setting and the effect on local environmental resources. Each of the resources and their respective issues are discussed in this chapter. The discussion generally includes both the project impact as if mitigation were not included and the result with mitigation.

GENERAL PROJECT SETTING

Climate

Imperial Valley climate is typical of a desert area and is characterized by hot, dry summers, occasional thunderstorms, and gusty high winds with sandstorms. Imperial Valley is one of the most arid areas in the United States with an average annual rainfall of 3 inches and a maximum temperature in excess of 100 degrees Fahrenheit (°F) more than 110 days per year. The highest recorded temperature of 119 °F has occurred several times. The frost-free period is greater than 300 days per year in 9 of 10 years.

Geographic and Geologic Setting

The All-American Canal (AAC) between Pilot Knob and Drop 4 traverses part of the Colorado River delta. From east to west, Pilot Knob Mesa, Sand Hills, and East Mesa are the physiographic features at the surface. Pilot Knob Mesa is a southerly extension of the Chocolate Mountains piedmont slope. Desert pavement on the surface is formed by erosional lag gravel of well-rounded rocks.

The Sand Hills are deposited on the mesa surface which is exposed locally in blowouts in the southeastern part of the dune field. East Mesa, a triangular area southwest of the Sand Hills, north of the international boundary, and east of the shoreline of prehistoric Lake Cahuilla, is a sloping plain that merges gradually with central Imperial Valley.

The Mesa[1] is underlain by thick non-marine deposits on deep igneous and sedimentary rocks. Some of the deposits were derived locally, but most were brought in by the Colorado River. The upper 1,000 feet or more of Mesa deposits are composed mostly of sand, typical of the sands deposited by the Colorado River, with lenses of clay which increase in thickness to the west. This trend continues

[1] Mesa as used herein includes all the separately named sections (Pilot Knob Mesa, East Mesa, and Andrade Mesa in Mexico) of the river terrace traversed by the AAC between Pilot Knob and Drop 4.

to the point that clay and silt predominate under the central Imperial Valley west of the Mesa. The thick stack of clay and silt deposited in the central Imperial Valley is the accumulated bottom deposits of many lakes and marine incursions which have occupied the Imperial Valley in the past.

Water in the Mesa deposits is hydraulically active, interacting with surface water, and forms an extensive ground-water aquifer. The Mesa deposits are part of the Colorado River Delta Aquifer which includes the eastern part of Mexicali Valley and all of the Yuma area. The active depth of the aquifer may be as great as several thousand feet. Moderate to high water yields can be obtained from wells in the deposits (high hydraulic conductivity) of the Mesa. In contrast, low yields are obtained from wells in the fine-grained deposits (low hydraulic conductivity) characteristic of the central part of the Imperial Valley.

The Mexicali Valley of Mexico lies to the south of the AAC section to be lined. This valley supports an extensive area of irrigated agriculture. Irrigation water is obtained by direct diversion from the Colorado River at Morelos Dam and by ground-water pumping in the eastern portion of the Mexicali Valley.

Seismicity

The Imperial Valley, a part of the Salton Trough, is one of the most seismically active areas in the world. Irrigation canals in the valley frequently are offset and damaged by earthquakes, and the Imperial Irrigation District (IID) must be prepared constantly to make quick repairs to avoid interruptions in water delivery.

Since about 1852, over 30 earthquakes with a magnitude 5 or greater have occurred in the Imperial Valley. The two strongest historic events to affect the area were the 1940 magnitude 7.1 and the 1979 magnitude 6.6 earthquakes. Both of these earthquakes occurred on the Imperial Fault, which crosses the AAC about 8 miles west of Drop 4 and caused extensive canal damage locally. Notably, however, serious canal damage did not occur to the AAC east of about Drop 4 during either earthquake. Historic earthquake ground acceleration, and therefore damage, has decreased rapidly east of Imperial Valley.

Along the section of the AAC considered for lining, several "potentially active" inferred faults, such as the Algodones and Sand Hills Faults, underlie the canal. These faults, if real, have much longer intervals between earthquakes than do the faults in the Imperial Valley. The Algodones Fault, as defined near Yuma, Arizona, has been inactive for the last 11,000 to 14,000 years. The fault is inferred to cross the AAC near Pilot Knob.

The Sand Hills Fault, inferred as crossing the canal around Drop 1, is probably similar to the Algodones Fault. In comparison to the Imperial Fault, the relative probability of a major surface-faulting earthquake occurring during the life of the proposed AAC lining project is extremely low. Moreover, the canal is cut into the ground along much of its length, providing protection against seismic damage related to earth displacement.

GROUND WATER

A large volume of water underlies much of the Mesa area. Although boundaries are undefined, available data suggest that this ground-water body extends eastward under the Colorado River to the Yuma area, westward at least as far as Drop 3, northward under the East Mesa, and

southward across the international boundary into Mexico (Loeltz et al., 1975). During years of normal flows on the Colorado River, approximately 10 to 12 percent of the total annual recharge of this ground-water aquifer is canal seepage between Pilot Knob and Drop 4. Upstream from Pilot Knob, the canal seepage returns to the Colorado River. Other sources of recharge are irrigation operations in the Mexicali Valley and infiltration through the bed of the Colorado River.

Affected Environment

Canal Seepage

Canal seepage is estimated from flow measurements near Pilot Knob, near Drop 1, and at the East Highline Canal turnout. These measurement points permit separate determinations of seepage upstream and downstream from Drop 1 (after adjustment for distances between measuring points and end points of the canal to be lined).

The seepage estimated in this manner fluctuates from year to year. This is attributed mainly to the fact that the volume of water lost from the canal as seepage is a small fraction of canal flow (2 percent) and is within the range of typical measurement error. Other unknown factors may also have an effect.

The seepage value used for project planning is the average of the yearly seepage values between Pilot Knob (Rock Section 2) and Drop 4, approximately 91,600 acre-feet per year. The period of record used excludes the first few years of data downstream from Drop 1, before the water table rose to the canal bottom.

The seepage per mile varies along the canal depending on connection (or lack thereof) between canal water and ground water directly beneath the canal and canal width. Generally, the water table upstream from Drop 2 is over 10 feet below the bottom of the canal (canal water is disconnected from the ground water). The water table downstream from Drop 2 is higher than the bottom of the canal for most of the distance (canal water is connected to the ground water). This connection reduces the rate of seepage per square foot of canal bottom. Also, the canal is about 10 percent wider above Drop 1. The result is that the seepage per mile upstream from Drop 2 is roughly three times the rate downstream from Drop 2. To assist in the analysis of alternatives, the canal was divided into four reaches. Table III-1 shows the estimated seepage by reach.

Water Table Elevation

The AAC seepage has formed a broad ground-water ridge under the canal. Observation well measurements show that the water table was 40 to 80 feet below the bottom of the canal prior to the canal being placed in service. At present, the water table is much higher. West of Drop 2, the water table is hydraulically connected to the canal water. Between Pilot Knob and Drop 2, the water table is also higher but is generally not hydraulically connected to the canal. Although seepage there is great, ground-water flow to the south prevents the seepage mound (or ridge) from rising to the canal. Discharge of seepage water occurs by subsurface drainage south toward Mexico (about 90 percent) and north toward the East Mesa (about 10 percent), and by negligible evapo-transpiration.

Table III-1.—Canal seepage by reach

Canal reach	Canal width (feet)	Length (miles)	Estimated seepage (acre-feet)
Reach 1 - Pilot Knob[1] to Drop 1	196	13.94	59,200
Reach 2 - Drops 1 to 2	177	5.21	17,900
Reach 3 - Drops 2 to 3	174	5.44	7,400
Reach 4 - Drops 3 to 4	173	5.29	7,100
Total		29.88	91,600

[1] Rock Section 2 on southeast side of Pilot Knob.

Since the mid-1950's, Mexico has pumped ground water each year from the Colorado River Delta Aquifer from wells located in the northeast section of the Mexicali Valley. The ground water pumped by the Mexicali well field comes from a combination of sources—ground water in storage, recharge from the Colorado River, seepage from canals in Mexico, deep percolation from irrigation, and seepage from the AAC.

The Lower Colorado Water Supply Project well field is being constructed along the canal in the Sand Hills area, as described in chapter I. Lining of the AAC was taken into account as the project was planned, and the wells have been designed to operate with a lower ground-water table.

Parallel Canal Alternative

Canal Seepage

The amount of water conserved by this alternative consists of the seepage through the unlined canal, minus the following two adjustments: (1) leakage through the lining and (2) an adjustment for the effect that lining one reach would have on the seepage of an adjacent, hydraulically connected reach. The estimate is 67,700 acre-feet per year as shown in table III-2.

The allowance for leakage through the lining of 0.07 cubic foot per square foot per day of wetted perimeter (submerged bottom and sideslopes) used for this analysis is based on operational information from good quality concrete lining.

A 2,000-acre-foot adjustment has been subtracted to account for increased seepage for a short distance downstream from Drop 3, as a result of lining to Drop 3. At present, the water table between Drops 3 and 4 is "connected" to the water in the canal. This connection reduces the seepage from what it would be if the water table were below the canal bottom. However, when the canal is lined to Drop 3, the water table around Drop 3 will drop, including a portion of the canal downstream. The downstream distance along which this would happen is not known, and the estimate is an approximation.

The allowance for leakage through the canal lining is subject to refinement through ponding tests to be made in the new canal sections and through operating experience after the canal is lined. The

Table III-2.—Water conserved by each action alternative (acre-feet)

Canal reach	Present seepage	Lined leakage[1]	Other adjustments	Water yield[2]
Parallel Canal Alternative	[3]84,500	[4]14,800	[5]2,000	67,700
Drop 3 Alternative	[3]84,500	15,800	[5]2,000	66,700
Drop 4 Alternative	91,600	18,900	[6]4,000	68,700
Well Field Alternative	[7]77,100	—	[8]9,100	68,000

[1] Allowance for seepage loss through lining, based on rate of 0.07 cubic foot per day per square foot of wetted perimeter.
[2] The amount of water conserved by the project alternative.
[3] Pilot Knob to Drop 3.
[4] Consists of leakage through lining plus seepage from 1.6 miles of canal left unlined, minus reduction in evaporation because of reduction in canal width.
[5] Both the Parallel Canal Alternative and the Drop 3 Alternative would increase seepage downstream from Drop 3 by approximately 2,000 acre-feet.
[6] Water for mitigation.
[7] Pilot Knob to Drop 2.
[8] Seepage not recovered.

estimate of the seepage from the unlined canal is subject to refinement with additional operational data prior to lining, and with ponding tests[2] on the old canal sections after removal from service.

Water Table Elevation

Lining the AAC would allow the ground-water ridge under the canal to decline. The decline would extend below the precanal ground-water level, which was roughly 40 to 80 feet below the canal, because of ground-water pumping in the Mexicali Valley of Mexico, which was not practiced before the canal was constructed. The ultimate depth of the water table decline under the AAC would depend on the amount of pumping in Mexico.

The project would reduce one of the water sources contributing to the wells in the Mexicali Valley well field. After lining, a new balance would be established between the ground water under the Mesa, the Mexicali Valley well field, and the remaining water sources. Under normal conditions, sources other than AAC seepage represent approximately 88 to 90 percent of the annual recharge. With continued pumping, the ground water under about 70 square miles of the northeastern portion of the Mexicali Valley would decline by depths ranging between 1 and 30 feet over a period of 50 years,

[2] A ponding test is conducted by filling a section of canal with water, isolating it from upstream and downstream sections, and measuring the rate at which the water in the canal section seeps into the ground.

assuming no change in the quantity of water presently being pumped. This information is from a ground-water analysis by Mexico which is presented in attachment D of the Geohydrology Appendix. It is not known how much of this area is under cultivation. Variations in well pumping in that portion of Mexico would result in less or greater change in the ground-water level. In addition, a portion of the ground water stored under the Mesa in the United States would be drawn into the supply for the Mexicali Valley well field.

The postlining water table decline may be temporarily halted whenever Colorado River flows spill from Morelos Dam. The resulting recharge of the aquifer under the Mexicali Valley by infiltration through the riverbed and canals in Mexico may temporarily raise ground-water levels. Periodic high flows from 1979 to 1993 led to a significant rise in the water table.

The Lower Colorado Water Supply Project well field is being developed to operate under conditions with canal lining. Thus, the Parallel Canal Alternative would not impact water production from the well field.

Drop 3 Alternative

Canal Seepage

This alternative would reduce the seepage by 66,700 acre-feet. Table III-2 shows the factors involved. An allowance for leakage through the lining of 0.07 cubic foot per square foot per day was used for this alternative because of the absence of operating experience with polyvinylchloride lining in large canals. The 2,000-acre-foot adjustment for increased seepage downstream from Drop 3 is the same as for the Parallel Canal Alternative.

The allowance for leakage through the canal lining is subject to refinement, as operating experience is obtained after the canal is lined. Also, the estimate of the seepage from the unlined canal is subject to refinement with additional operational data prior to lining.

Water Table Elevation

The water table change under the canal would be the same as for the Parallel Canal Alternative, except that the effect would extend upstream an additional 1.6 miles.

The effect on ground water under the Mexicali Valley would be similar to that of the Parallel Canal Alternative.

The Lower Colorado Water Supply Project well field is being developed to operate under conditions with canal lining. Thus, the Drop 3 Alternative would not impact water production from the well field.

Drop 4 Alternative

Canal Seepage

This alternative would reduce the seepage by 68,700 acre-feet. Table III-2 shows the factors involved. The leakage allowance through the lining would be the same as for the Drop 3 Alternative, applied to an additional 5 miles.

Water Table Elevation

In addition to the water table declines noted for the previous alternatives, this alternative would cause the water table to drop about 40 feet under the canal between Drops 3 and 4 but would not lower the water table below the canal bottom downstream from Drop 4.

The effect on ground water under the canal and under the Mexicali Valley would be similar to that under the Parallel Canal Alternative.

The Lower Colorado Water Supply Project well field is being developed to operate under conditions with canal lining. Thus, the Drop 4 Alternative would not impact water production from the well field.

Well Field Alternative

Canal Seepage

While the well field would recover 68,000 acre-feet per year, canal seepage would be unchanged under this alternative.

The proposed location of the west end of the well field would be approximately halfway between Drops 1 and 2. The exact location would be governed by the following considerations. At Drop 2 and westward, canal water is connected to the ground water. East of Drop 2, the canal water is not connected to the ground water. The location of the furthest west well would be chosen to avoid the potential for steepening the slope of the ground water (hydraulic gradient) away from the canal downstream from Drop 2, which would increase seepage downstream from Drop 2. The portion of the canal immediately below Drop 1 that is connected to the ground water is not expected to be affected by the well field.

The location of the easternmost well probably would be set west of Pilot Knob, approximately at the intersection of Sidewinder Road. The reason for this is that further east, the bedrock may be relatively close to the wells, which would impede efficient recovery of seepage with wells.

The final location of the endpoints of the well field would be determined during the project design phase, during which additional geologic studies would be performed.

Water Table Elevation

This alternative would cause the water table under the canal and under the Mexicali Valley of Mexico to drop about as much as under the lining alternatives. However, the water table would rise during periods when the well field is not operated. This could occur during years when surplus water flows in the Colorado River.

The Lower Colorado Water Supply Project well field being developed along the canal in the Sand Hills is designed to operate under postlining ground-water levels. Because the Well Field Alternative would affect the water table approximately the same as constructing a canal lining, there would be no impact on water production from the Lower Colorado Water Supply Project well field.

No Action Alternative

Canal Seepage

Without the project, the AAC between Pilot Knob and Drop 4 would continue to lose approximately 91,600 acre-feet of water per year to seepage.

Water Table Elevation

The operation of the canal would cause no change in ground-water levels under the canal or under the Mexicali Valley of Mexico. Most of the seepage water would continue to flow southward across the international boundary. Ground-water

levels under the Mexicali Valley of Mexico may vary depending on variations in well pumping in Mexico.

Under this alternative, the water table at the Lower Colorado Water Supply Project well field would not be affected by canal lining. This would reduce the projected cost of pumping the wells, which would have a beneficial financial impact on the Lower Colorado Water Supply Project. The estimated cost reduction is between $3 and $5 per acre-foot, depending on how far the water table would drop after lining and on the price of electric power for pumping.

SURFACE WATER

The desert terrain traversed by the canal is devoid of perennial surface water except for the AAC. At Pilot Knob and for a short distance to the west, the AAC intersects minor dry washes that occasionally flow with runoff from summer thunderstorms. The flow of these washes either enters the canal through concrete drainage inlet structures or ponds up against the outside of the north canal bank and seeps into the ground.

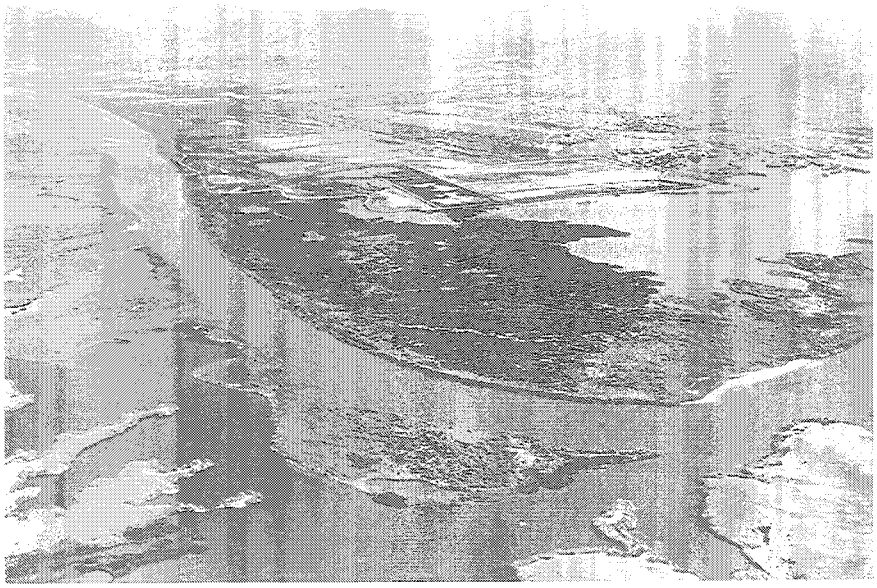


Photo 3.—Colorado River about 7 miles upstream from the Imperial Dam.

Affected Environment

All-American Canal

The AAC conveys water year round. Between Pilot Knob and Drop 1, the original design capacity is 10,155 cubic feet per second (ft^3/s); below Drop 1, point of diversion for the Coachella Canal, the capacity is about 7,600 ft^3/s. Actual discharge below Drop 1 ranges from 2,000 ft^3/s in January to a high of about 5,000 ft^3/s in May, and stays above 4,250 ft^3/s from April through October. Checkgates at each drop structure generally keep the canal operating as full as possible. The water volume in the canal includes both operational storage and an emergency water supply.

Colorado River

The flow of the Colorado River between Parker and Imperial Dams generally is set at the amount needed to meet diversion requirements in the United States (including the AAC) plus delivery to Mexico.[3] During the spring, summer, and fall, the average monthly flow of the river as it approaches Imperial Dam varies between 9,000 and 11,000 ft^3/s. During winter months, the average monthly flow drops to about 5,000 ft^3/s.

Downstream from approximately halfway between Blythe, California, and the Imperial Dam, the river has a relatively low gradient and a substantial number of backwaters. The area of the backwaters is estimated at 3,300 acres, and the area of the river at 1,300 acres.

Salton Sea

The Salton Sea, formed by the flood of 1905-07, is maintained by the flows of irrigation drainage and natural runoff that drain to the lowest part of the Salton Sea Basin. The Salton Sea was formed in the lowest part of that basin, 278 feet below sea level. The 360-square-mile lake is the largest in the State. The water level of the Salton Sea currently fluctuates between 226 and 228 feet below sea level.

Parallel Canal Alternative

All-American Canal

Total water diversion from the Colorado River at Imperial Dam would likely be reduced by 67,700 acre-feet annually or about 2 percent of the future anticipated total delivery.

This alternative would decrease the volume of water in the canal between Pilot Knob and Drop 4 from the present 8,630 acre-feet to 6,800 acre-feet at design flow conditions. The actual volume of water in the canal depends on silt buildup and hydraulic factors such as flow rate and the depth to which the water is checked at drop structures. These factors are dynamic and vary seasonally. The parallel canal is estimated to decrease the canal volume a maximum of about 1,500 acre-feet under average flow conditions.

Before the new canal is connected to the existing canal at existing structures, each reach would be filled with water and left to stabilize for a month or two. Ponding tests would then be conducted in the new canal

[3] Exceptions occur during periods of surplus riverflow or unanticipated rainstorms; and when delivery requirements are less than 2,000 ft^3/s, the minimum flow rate generally provided.

to refine the estimates of leakage through the canal lining. When completed, the new canal would be connected to the old canal, and the flow diverted into the new canal. After the diversion, ponding tests would be conducted on the old canal to refine the estimate of seepage under present conditions.

The water districts would retain the old canal for use as a temporary emergency channel in the event that a section of the new canal suffers significant damage from an earthquake or other catastrophe. The old canal could then be used while repairs are made. Water would be diverted into the old canal through gates to be constructed where the new canal sections are connected to the old canal or by other means. An operation and maintenance plan for the old canal would be developed during project design.

Colorado River

The Parallel Canal Alternative would have the beneficial impact of increasing the usable water supply of the Colorado River by 67,700 acre-feet per year.

The Parallel Canal Alternative would reduce the average flow of the lower Colorado River by approximately 94 ft^3/s. The flow reduction would reduce the level of the river downstream from Blythe by about one-half inch.

This reduction in water level would reduce the area of the river and its backwaters by a small amount. The irregular nature of the river and its backwaters make it difficult to quantify the area reduction. At a maximum probable impact, 4-1/2 acres is estimated. This would be about one-tenth of 1 percent of the present backwater area. There would be no change in riverflow, water level, or water surface area during periods of minimum flow, or when surplus water in the river causes abnormally high flow.

Salton Sea

It is estimated that less than 5 percent of the annual seepage from the canal upstream from Drop 3 flows northward under the East Mesa. However, the hydraulic conductivity between East Mesa and the Salton Sea is so low that no seepage water is estimated to enter the Salton Sea directly through the subsurface. It is conceivable that some of the water makes its way to the drains in the IID irrigated area. However, not enough is known about ground-water movement under the East Mesa or the seepage and drainage regime at the East Highline Canal to determine whether AAC seepage from above Drop 3 enters drains. It is concluded that the amount of seepage that reaches the Salton Sea is insignificant, and that the project would not have a significant effect on the level of the Salton Sea.

Drop 3 Alternative

All-American Canal

Total water diversion would likely be reduced by 66,700 acre-feet annually or about 2 percent of future anticipated total delivery.

This alternative would increase the volume of water in the canal from the present 8,630 acre-feet to 8,900 acre-feet under design flow conditions. Under normal flow, in-place lining is estimated to increase the volume of water by an insignificant amount.

Colorado River

The proposed project would have the beneficial effect of increasing the usable water supply of the Colorado River by 66,700 acre-feet. The effect on riverflow, water level, and water surface area would be the same as for the Parallel Canal Alternative.

Salton Sea

Same as for the Parallel Canal Alternative.

Drop 4 Alternative

All-American Canal

Total water diversion would likely be reduced by 68,700 acre-feet annually or about 2 percent of future anticipated total delivery.

This alternative would increase the volume of water in the canal from the present 8,630 acre-feet to 9,300 acre-feet under design flow conditions. Under normal operation conditions, in-place lining is estimated to increase the volume of water in the canal by an insignificant amount.

Colorado River

The proposed project would have the beneficial effect of increasing the usable water supply of the Colorado River by 68,700 acre-feet. The effect on riverflow, water level, and water surface area would be the same as for the Parallel Canal Alternative.

Salton Sea

Same as Parallel Canal Alternative.

Well Field Alternative

All-American Canal

The amount of seepage recovered by the wells would be 68,000 acre-feet per year, or about 2 percent of future anticipated flow. There would be no change in the volume of water in the canal.

Colorado River

The proposed project would have the beneficial effect of increasing the usable supply of the Colorado River by 68,000 acre-feet per year. The effect on riverflow, water level, and water surface area would be the same as for the Parallel Canal Alternative.

Salton Sea

Same as for the Parallel Canal Alternative, except that the chance of an effect on the Salton Sea is more remote because the well field would end between Drops 1 and 2.

No Action Alternative

All-American Canal

This alternative would not have an effect on the AAC.

Colorado River

This alternative would not have an effect on the river.

Salton Sea

This alternative would not affect the inflow to the sea.

WATER QUALITY

Affected Environment

Water quality of the AAC reflects that of its source, the Colorado River. Table III-3 presents a summary of 1987 AAC water quality data below Drop 1.

Canal water temperatures vary with seasons and air temperatures. Since the canal is a continuously flowing system, dissolved oxygen concentrations are normally high. Turbidity, related to total suspended solids, varies greatly. The canal water tends to be less turbid in winter when flows are low. Water may be murky (underwater visibility about 1 foot) in summer when the water velocity is great enough to cause bank erosion and scour silt deposits in the canal bottom and prevent fine particles from settling out. Water quality is considered good for fish, especially in regard to dissolved oxygen levels and temperature regimes.

The salinity of the Colorado River varies from year to year depending on the amount of runoff from the Colorado River Basin. Since 1980, the flow-weighted average annual salinity has varied between 577 milligrams per liter (mg/L) and 826 mg/L. While the salinity is caused primarily by saline inflows from various sources, the fluctuation is caused primarily by the amount of water in the river, which dilutes the salt. For example, the period of high water beginning in 1983 produced a reduction in salinity. The Federal Colorado River Water Quality Improvement Program has the objective of limiting the salinity at Imperial Dam to 879 mg/L.

The Lower Colorado Water Supply Project well field, described in chapter I, is being constructed along the canal in the Sand Hills area. The quality of the ground water

Table III-3.—All-American Canal water quality data, 1987[1]

Date	Discharge (ft^3/s)	Temperature (°F)	Total dissolved solids (ppm)[2]	pH
01/07/87	2,000.0	54	692	7.7
02/04/87	3,275.0	54	504	7.3
03/04/87	3,350.0	57	520	7.2
04/01/87	4,750.0	60	565	7.5
05/06/87	5,550.0	73	509	8.0
06/03/87	4,650.0	77	680	7.4
07/01/87	4,500.0	78	662	7.9
08/05/87	5,101.0	82	650	7.6
09/02/87	4,285.0	84	699	8.0
10/07/87	4,471.0	76	658	8.1
11/04/87	869.0	70	610	7.6
12/02/87	3,089.0	57	690	8.4

[1] Sample location was below Drop 1, 1987, IID.
[2] Parts per million.

under the canal in the vicinity of the well field is similar to that of Colorado River water. Lining of the AAC was taken into account as the project was planned, and the wells have been designed to operate with a lower ground-water table. However, only scant data existed on the aquifer characteristics and water quality conditions of ground water to the north of the well field.

In the Mexicali Valley of Mexico along the foot of the Mesa, ground water seeps into the Mesa Drain. The ground water consists of irrigation return flow and AAC seepage. Surface drainage also flows into the Mesa Drain. Irrigation drainage water is pumped out of the Mesa Drain for reuse on irrigated agriculture. Some of the drainage water reused in this manner originates in the northeastern portion of the Mexicali Valley in the area in which ground water would be affected by lining the canal. Only scant data on the quality and other characteristics of ground water in Mexico exists.

Parallel Canal Alternative

Permanent Impacts

This alternative would tend to increase the salinity of the Colorado River below Parker Dam because the reduction in flow between Parker and Imperial Dams would tend to provide less dilution for drainage inflow to the river. The increase in salinity, estimated at about one-half mg/L, would not be measurable. In the canal, the annual cycle of clear water in winter and murky water in summer would continue, but high-flow turbidity would decrease by an undetermined amount.

At the Lower Colorado Water Supply Project well field, the water level at the well field would be expected to drop if pumping in the Mexicali Valley continues at historic levels. Ground water to the north would then be expected to migrate into the well field area.

Because the canal seepage water is of better quality than some other ground water in the aquifer, it is expected that ground-water quality will degrade somewhat after the canal is lined. As a maximum probable impact, it is estimated that the total dissolved solids in the well water would increase at a rate of 2 mg/L per year after the lining is installed. However, this rate of degradation is based on the wells being pumped at capacity, which is about twice the rate currently projected. Reducing the AAC seepage would cause the ground-water table to decline as discussed under "Ground Water." The decline would reduce the amount of ground water that seeps into the Mesa Drain. This information is from a ground-water analysis by Mexico which is presented in attachment D of the Geohydrology Appendix.

Due to the reduced amount of ground water entering the drain system from the northeastern part of the Mexicali Valley of Mexico, the quality of agricultural drainage water in the Mesa Drain, which is reused for irrigated agriculture, would deteriorate.

Impacts During Construction

Construction of the tie-ins between the new canal and the old would cause temporary turbidity in the canal water. This would be similar to that caused during routine canal maintenance operations, which is not a problem. The tie-ins would be constructed during low flow periods, which would minimize the downstream travel of turbid water.

Drop 3 Alternative

Permanent Impacts

Same as Parallel Canal Alternative.

Impacts During Construction

Because the canal has a warmwater fishery, the temporary effects of the in-place lining process on water quality were of concern. Therefore, three water quality parameters—turbidity, pH, and temperature—were examined in the laboratory and during the experimental canal lining work performed between Siphons 14 and 15 of the Coachella Canal.

Turbidity—The concern was whether additional turbidity in the water might potentially be generated by removing silt from the canal, placement of concrete, and erosion of partially cured concrete. Test results indicated turbidity from concrete erosion would settle rapidly—i.e., to near background levels within half a mile downstream of the lining operation. On the other hand, fine soil particles are relatively slow to settle. Observations in the Coachella Canal indicated that the turbidity generated by the project would be similar to that caused during routine canal maintenance operations; therefore, temporary turbidity is not a problem.

pH—The concern was whether the reaction between the canal water and cement paste might increase the pH in the canal over the Coachella Canal background level. This would affect the equilibrium of the existing ammonia-nitrate (ammonia-N), i.e., shift from the ionized form to the nonionized form, which is considerably more toxic to aquatic life. A pH exceeding 9.0 could be a biological hazard.

Laboratory tests indicate that the pH change would be roughly proportional to the amount of cement paste lost from scour and from the equipment during placement and, under a reasonable construction scenario, would not exceed 0.2 standard pH units. Measurements during lining placement in the Coachella Canal in February 1991 showed an average pH rise of 8.21 to 8.25, which is not of concern. To assure that the pH does not exceed 9.0 units, equipment would be on hand to add hydrochloric acid to the canal water at the construction site, if needed. The amount added would not affect the quality of the canal water for domestic or agricultural use.

Temperature—The concern was whether canal water temperature would be affected by heat generated during the chemical reactions involved in the hardening of concrete, and whether such heat might affect the equilibrium of ammonia-N. Laboratory tests indicate that the temperature increase in the canal resulting from the concrete hardening would be very slight, well below 2.0 °F. Measurement in the canal indicates a maximum change of 0.2 °F. Therefore, temperature change is not of concern.

Monitoring Program—A canal water quality monitoring program would be conducted during construction. If pH tolerances are exceeded, work will be suspended until the problem is resolved. In addition, any water quality permits required, such as a section 402 (Clean Water Act) permit administered by the

California Regional Water Quality Control Board, would be obtained as required.

Drop 4 Alternative

Permanent Impacts

Same as Parallel Canal Alternative.

Impacts During Construction

Impacts and monitoring would be the same as for the Drop 3 Alternative.

Well Field Alternative

Permanent Impacts

Impacts on the Colorado River would be the same as for the Parallel Canal Alternative.

This alternative could increase the salinity of the AAC, although the potential for a measurable increase is believed to be low. Ground water of higher salinity than AAC water is known to exist under the East Mesa north and west of the proposed westernmost wells (west of Drop 1). Locally, a shallow clay layer (exact areal extent unknown) is also known to exist west of Drop 1. The combination of relatively close, poorer quality ground water and the potential for a relatively poor local connection between canal seepage and the local recovery wells caused by the clay layer could induce movement of the poor quality ground water toward the wells.

Whether this would occur, and the degree to which this would occur, would depend on the degree of underground hydraulic connection between the wells and poorer quality ground water to the north and west, compared to the hydraulic connection between the wells and canal seepage. Because the annual volume of well water would be approximately 2 percent of the water conveyed by the canal, ample dilution would occur.

The quality of ground water under the canal east of Drop 1 is at or near the quality of Colorado River water, so significant degradation of the pumped water by poor quality ground water is not a concern.

This alternative is not expected to reduce the quality of the water pumped from the wells of the Lower Colorado Water Supply Project.

Water quality would be monitored during project operation to provide advance indication of degradation that may impact the users of canal water in the Imperial and Coachella Valleys, or the fishery in the canal. If the water quality of the wells deteriorates to a detrimental level, project operation would be changed as needed to minimize or avoid the problem.

The development of a water quality problem is deemed unlikely. While the salinity tolerance of all the fish in the AAC is not known, the slight increase that could be caused by the wells would have no impact on the fishery.

The impact of this alternative on the Mexicali Valley of Mexico would generally be the same as for the Parallel Canal Alternative, although the area of effect in Mexico would probably be smaller because the well field would end east of Drop 2.

Impacts During Construction

This alternative would have no impact on AAC water quality during construction.

No Action Alternative

This alternative would not have an effect on the water quality in the Colorado River and the AAC.

The No Action Alternative may have a beneficial impact on quality of water pumped from the Lower Colorado Water Supply Project well field. The continued seepage from the canal would assure that a substantial part of the well water would be recent canal water. This would reduce the possibility of degradation of the ground-water quality by migration of other ground water.

The operation of the canal would cause no change in the water quality of the Mexicali Valley of Mexico.

AIR QUALITY

Affected Environment

The project area is located in the Southeast Desert Air Quality Control Region of California. Imperial County is a nonattainment area for ozone and particulates (PM-10 category).

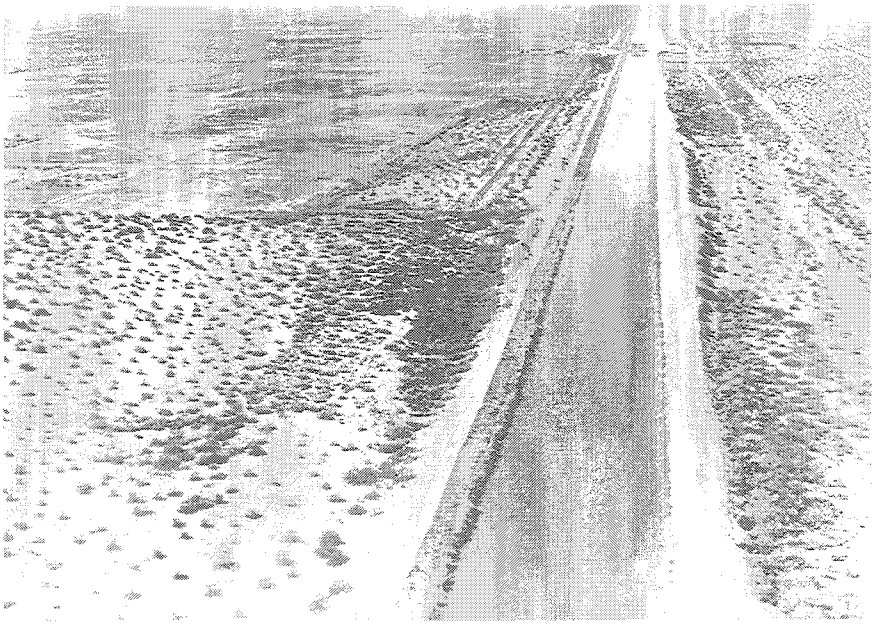


Photo 4.—Looking west, view shows typical small patches of wetlands habitat along the All-American Canal upstream from Drop 3 (shown in background).

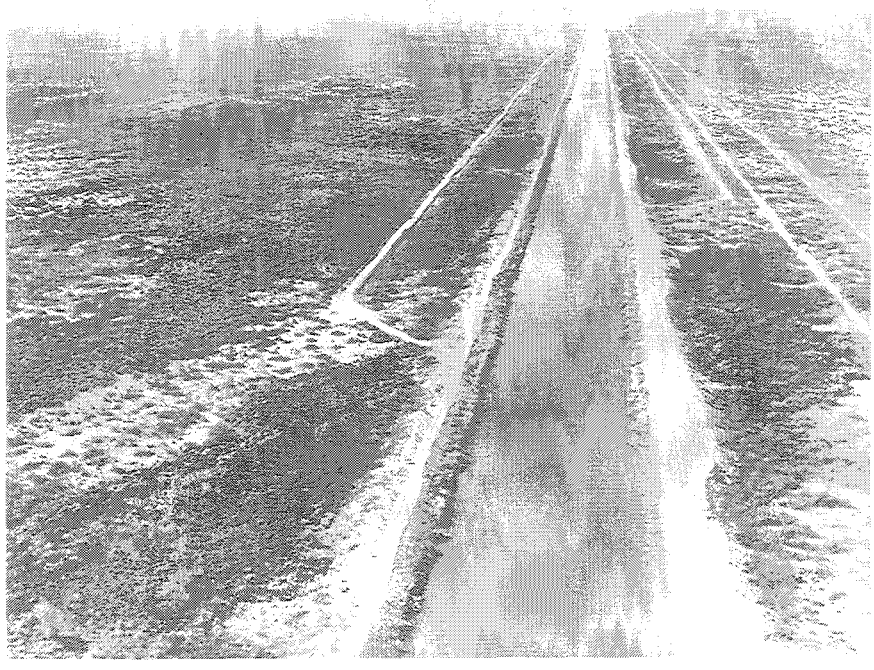


Photo 5.—Looking west, view shows large wetlands complex along All-American Canal between Drops 3 and 4. Drop 4 is in background.

Parallel Canal Alternative

The effect of this alternative on air quality would be temporary, in the form of dust created by excavation of the new canal, operation on unpaved roads, equipment exhaust emissions, and batch plant emissions of dust and engine exhaust.

Emissions would be controlled in accordance with regulations of the Imperial County Air Pollution Control District. Permits required for the various construction activities would be obtained. Dust from construction activities would be localized and would be controlled by sprinkling access roads and work areas with water.

Drop 3 Alternative

The effect would be similar to that of the Parallel Canal Alternative, except that dry excavation would be limited to canal bank trimming, and less equipment would be used. Mitigation measures would be the same as for the Parallel Canal Alternative.

Drop 4 Alternative

The effect would be similar to that of the Parallel Canal Alternative, except that dry excavation would be limited to canal bank trimming and less equipment would be

used. Mitigation measures would be the same as for the Parallel Canal Alternative.

Well Field Alternative

The effect of this alternative on air quality would be temporary, in the form of dust created by shaping the maintenance road and drill sites prior to paving them with gravel and in the form of exhaust from drilling and hauling equipment. Mitigation measures would be the same as for the Parallel Canal Alternative.

No Action Alternative

This alternative would not have an effect on air quality.

WETLANDS HABITAT ALONG THE ALL-AMERICAN CANAL

Affected Environment

Seepage from the AAC has induced wetlands vegetation to develop along the canal in a landscape that was previously dry desert. Wetlands habitat maintenance is a national priority, which has been set in response to dwindling habitat for waterfowl and other wildlife nationwide.

The seepage wetlands along the AAC provide significant habitat value for wildlife. At least 170 species of birds, 27 species of mammals, and 5 species of reptiles and amphibians are associated with the wetlands complex. The federally listed endangered Yuma clapper rail and 15 Federal candidate species use the wetlands.[4] In addition, 27 species of birds, which have been designated rare or endangered by the California Department of Fish and Game (CDFG) or species of special concern by the National Audubon Society, could occur in the wetlands.

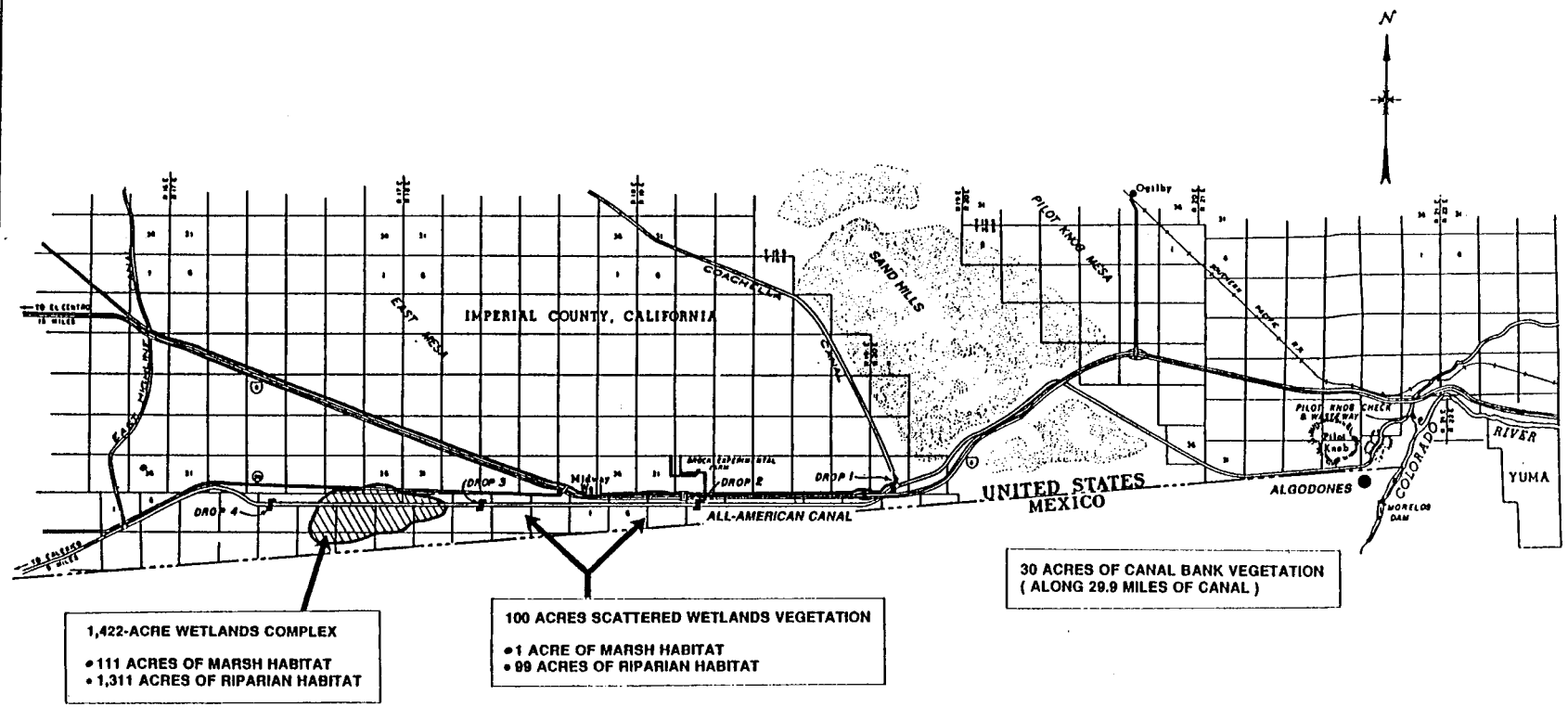
Location of Wetlands

The intersection of topographic lows and the seepage-maintained high water table has induced 1,422 acres of wetlands between Drops 3 to 4 (figure III-1). About 111 acres (9 percent) of the total area is marsh vegetation. Salt cedar constitutes about 755 acres (53 percent) of the total, arrowweed 233 acres (16 percent), and screwbean mesquite 251 acres (18 percent). The cottonwood/willow vegetation type accounts for 39 acres (3 percent) of the total area. There are 4.6 acres of open water in the complex associated with small recapture ditches on the sides of the canal.

Another 100 acres of seepage-induced wetlands occur along the AAC between Drops 2 and 3. These wetlands are not in a single contiguous vegetation complex, but rather scattered along both sides of this 5.4-mile section of canal. About 50 percent of the total is arrowweed, 30 percent salt cedar, and 20 percent screwbean mesquite. One acre is marsh vegetation.

In addition, an almost continuous thick stand of common reed, 3 to 15 feet wide, grows along both sides of the AAC for most of its length. From Pilot Knob to Drop 4, there are a total of about 30 acres of the canal bank vegetation; and from Drops 3 to 4, there are about 6 acres.

[4] A list of endangered species was provided by the U.S. Fish and Wildlife Service in accordance with section 7(c) of the Endangered Species Act of 1973, as amended.



EXISTING WETLANDS

ALL-AMERICAN CANAL LINING PROJECT
IMPERIAL COUNTY, CALIFORNIA

Figure III-1

Recapture ditches, used to collect seepage from the canal, run parallel to the south side of the canal for about 2 miles and the north side for about 1.7 miles between Drops 3 and 4. These ditches account for all 5 acres of open water in the area. Water is pumped from these ditches back into the canal.

For a broader perspective, studies recently completed by IID in conjunction with their water conservation program identified about 9,200 acres of wetlands in that investigation study area.[5]

Classification of Wetlands

Wetlands are defined by the U.S. Fish and Wildlife Service (FWS) as lands transitional between terrestrial and aquatic systems where the soils are wet or flooded. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land predominantly supports plants requiring wet soils; (2) soils are saturated, flooded, or ponded long enough during the growing season to develop anaerobic (lack of oxygen) conditions in the upper part; and (3) soils are saturated with water or covered by shallow water at some time during the growing season of each year.

The AAC seepage wetlands have been separated into two vegetation categories—marsh and riparian. Marsh vegetation is characterized by cattail and bulrush, which are associated with saturated surface soil conditions. The marshes along the AAC often border small areas of open water and are dominated by narrowleafed cattail, which in some areas form dense and impenetrable stands.

Riparian vegetation in the study area is characterized by vegetation that thrives over elevated ground-water levels and benefits from occasional flooding, but is not adapted to permanent saturated surface soils. Included are salt cedar, arrowweed, honey mesquite, screwbean mesquite, black willow, and Fremont cottonwood.

A riparian vegetation classification and habitat valuation system was developed by Anderson and Ohmart (1984) for application along the Colorado River. The habitat values were adapted to account for differences between Drop 4 wetlands and the Colorado River by a biological work group representing five Federal agencies, one State agency, and three local agencies.

The six designated riparian vegetation community types used in this study are cottonwood/willow, screwbean mesquite, honey mesquite, honey mesquite-salt cedar, salt cedar, and arrowweed (table III-4).

The six marsh types presented in table III-5 were adopted from the marsh classification system used in a 1986 lower Colorado River vegetation mapping effort (Younker and Andersen, 1986).

Assignment of Habitat Values

Based on documented use—primarily by birds and small mammals—of the vegetation structure community type, Anderson and Ohmart assigned numeric values to each community type ranging from 1 to 26, with higher numbers reflecting greater habitat value (table III-4). The communities are also

[5] Study area included: AAC from Drop 3 to East Highline Canal; East Highline Canal; Alamo River from AAC to Salton Sea; New River from AAC to Salton Sea; Salt Creek Slough; and a 2- to 3-mile segment of the San Felipe Wash (IID, 1986).

Table III-4.—Relative habitat values of riparian vegetation communities as used in the All-American Canal wetlands analysis[1]

Community	Structure	Value	Community	Structure	Value
Cottonwood/willow	I	17	Salt cedar	I	4
	II	23		II	8
	III	26		III	5
	IV	19		IV	3
	V	5		V	5
	VI	6		VI	7
Screwbean mesquite	II	8	Honey mesquite	III	20
	III	15		IV	21
	IV	9		V	10
	V	9		VI	9
	VI	4			
Salt cedar/ Honey mesquite	IV	8	Arrowweed	IV	1

[1] Anderson, B.W., and R. Ohmart, 1984, *Vegetation Management Study for the Enhancement of Wildlife Along the Lower Colorado River.*

Table III-5.—Marsh classification system for the Lower Colorado River region (Younker and Andersen, 1986)

Marsh type	Description
1	Nearly 100 percent cattail/bulrush, small amounts of reeds and open water.
2	Nearly 75 percent cattail/bulrush, many trees and grasses interspersed.
3	About 25 to 50 percent cattail/bulrush, some reeds, open water, some trees, and grass.
4	About 35 to 50 percent cattail/bulrush, many trees and grasses interspersed.
5	About 50 to 75 percent cattail/bulrush, few trees and grasses interspersed.
6	Nearly 100 percent reeds, little open water.
7	Open marsh (75 percent water), adjacent to sparse marsh vegetation; includes sandbars and mudflats when Colorado River is low.

divided into six structural types based on distribution of foliage at various heights, density, and patchiness. In general terms, types I through III represent relatively tall stands of riparian trees; types IV through VI are shrub communities or stands of short trees.

The values were assigned to the acreages of the various communities of the Drops 3 to 4 wetlands complex. A total of 7,703 habitat value units are associated with existing seepage wetlands vegetation. Table III-6 summarizes the total values and areas of existing seepage wetlands resources along the AAC from Pilot Knob to Drop 4.

Habitat values were not assigned to areas of marsh vegetation because the biological work group determined that "value-trading" would not be appropriate for marsh habitat. Acre-for-acre replacement was judged appropriate.

Wetlands Goal

Executive Order 11990, Wetland Management, was enacted to assist in avoiding adverse impacts to wetlands. This order provides for a process to improve and coordinate Federal plans, functions, programs, and resources in a manner to attain beneficial use without impacting wetlands. Federal agencies are required to find that there are no practicable alternatives to such construction and that proposed actions include all practicable measures to minimize impacts to wetlands. The project would conform to these standards.

The majority of seepage wetlands acreage in the AAC study area is either salt cedar or arrowweed. Salt cedar is a nuisance plant, and both have minimal wildlife value. Accordingly, FWS endorses the concept of no net loss in wetlands *habitat values* for the riparian component in this study area through replacement of salt

Table III-6.—Summary of existing seepage wetlands vegetation along the All-American Canal from Pilot Knob to Drop 4

Vegetation/type	Area (acres)	Percent of total area	Habitat value	Percent of total habitat value
Cottonwood/willow	39.1	3	743	10
Screwbean mesquite	273.1	18	2,458	32
Honey mesquite	3.1	*	56	1
Honey mesquite/salt cedar	31.1	2	249	3
Salt cedar	783.2	50	3,917	50
Arrowweed	280.3	18	280	4
Marsh	111.7	7	NA	NA
Canal bank	30.0	2	NA	NA
Total	1,551.6	100	7,703	100

Note: Asterisk (*) indicates less than 1 percent.
NA = Not applicable.

cedar and arrowweed with other more desirable species of plants. This concept does not apply to the marsh component, which would be mitigated in-kind.

Seepage-induced wetlands mitigation plans for all project alternatives conform to the following guidelines:

- Avoidance of impact is the preferred mitigation.
- When avoidance cannot be achieved, in-place, in-kind mitigation should be the goal.
- Mitigation for marsh vegetation communities within the wetlands areas must be in-kind.
- Habitat value assignment and exchanges are appropriate for the AAC riparian vegetation.

Parallel Canal Alternative

This alternative would avoid impacting the principal wetlands complex, thereby affecting only about 99 acres of scattered riparian vegetation, 1 acre of marsh vegetation, and 24 acres of canal bank vegetation.

Effect on Wetlands

All 100 acres of seepage wetlands vegetation located between Drops 2 and 3, except for less than 1 acre of honey mesquite, would be lost because of mechanical removal or the decline of the ground-water table. Twenty-four acres of canal bank vegetation would be lost when the existing canal dries up. The principal wetlands complex between Drops 3 and 4 would not, however, be impacted and would continue in its current condition. Table III-7 summarizes the acreage of vegetation types that would remain without mitigation.

Table III-7.—Summary of All-American Canal seepage wetlands acreage for current conditions (no action) and future scenarios (without mitigation)

Vegetation type	No Action and Well Field Alternatives	Parallel Canal Alternative	Drop 3 Alternative	Drop 4 Alternative
Cottonwood/willow	39.1	39.1	39.1	0.0
Screwbean mesquite	273.1	251.1	251.2	0.0
Honey mesquite	3.1	2.4	3.1	3.1
Honey mesquite/ salt cedar	31.1	31.1	31.1	31.1
Salt cedar	783.2	754.5	754.5	0.0
Arrowweed	280.3	233.1	233.1	0.0
Marsh	111.7	110.8	110.8	0.0
Canal bank	30.0	6.0	6.0	0.0
Totals	1,551.6	1,428.2	1,428.9	34.2

Loss rate for the vegetation types would vary. Based on review of vegetation response to the first 49 miles of Coachella Canal lining, marsh vegetation would die within the first year or two following the lining. Most of the arrowweed would die within the first 10 years, and most of the screwbean mesquite would gradually decline during the first 10 postlining years.

Salt cedar would eventually die out as the ground-water level declined beyond the growth range of root systems. Only honey mesquite would have the ability to survive because of the capability of its root system to follow the declining ground-water level.

Mitigation Plan

The Parallel Canal Alternative achieves the mitigation goal of "avoidance of impact" to the maximum degree possible. Mitigation for the unavoidable impacts to other wetlands vegetation would be achieved by replacing lost riparian habitat values and 1 acre of marsh vegetation through habitat creation in and adjacent to the Drops 3 and 4 wetlands complex.

Forty-three acres of honey mesquite and/or cottonwood/willow (24 acres for canal bank vegetation and 19 acres for other wetlands vegetation) and 1 acre of marsh would be established in the wetlands complex. The number of plantings in riparian vegetation mitigation sites would be designed to achieve a density of about 100 mature trees per acre, pursuant to research completed along the lower Colorado River. Planting honey mesquite/quailbush associations may be appropriate in areas of high-salinity soils. Specific vegetative establishment sites would be selected based upon physical and biologic suitability criteria (e.g., soil electroconductivity and texture, depth to ground water, topography, presence or absence of other vegetation), avoidance of disruption of existing riparian and marsh vegetation, and maximization of value to specific wildlife species of special concern, such as the federally endangered Yuma clapper rail and California black rail.

Based on the guidelines above, a site-specific plan for mitigation would be developed. The plan would be reviewed and approved by the appropriate entities prior to implementation. Improvements would be in place prior to disturbance of wetlands located between Drops 2 and 3.

Monitoring Plan

A monitoring plan would also be implemented. The mitigation site would be monitored monthly during the first and second year growing seasons, twice annually during years 3 through 5, and annually for years 6 through 10. The site would then be monitored in postplanting years 15, 20, and 25. The mitigation plan would be reviewed following each survey year to see if plan modifications or corrective actions are required. In addition, the Drops 3 to 4 wetlands complex would be monitored for nonproject-related changes.

Drop 3 Alternative

The effects on wetlands resulting from this alternative would be approximately the same as for the Parallel Canal Alternative. One difference is that the canal bank vegetation would be mechanically removed to prepare for lining, rather than left to dry out. Mitigation would be the same as for the Parallel Canal Alternative.

Drop 4 Alternative

Effect on Wetlands

Without mitigation, all seepage wetlands vegetation along this length of the canal would be lost with the exception of honey mesquite. The 31 acres of honey mesquite/ salt cedar vegetation in the Drops 3 and 4 wetlands complex would gradually evolve into a honey mesquite vegetation community, and the 3 acres of honey mesquite would persist. Relative rates of impacts to the other vegetation would be the same as described for the Parallel Canal Alternative.

The project would result in the loss of 1,518 acres of wetlands vegetation, with a value of 7,398 habitat units. This loss is tabulated in table III-8.

Mitigation Plan

A plan was developed to provide full mitigation for impacts to the Drops 3 to 4 wetlands complex that would result from in-place lining of the AAC from Pilot Knob to Drop 4. The plan creates an equal value wetlands complex (369 acres of riparian vegetation, 112 acres of marsh vegetation) on the same Drops 3 to 4 site. Table III-8 shows an estimate of acreages needed. Water would be delivered from the AAC to meet the estimated 4,000-acre-foot annual requirement.

Detailed planning for design of the wetlands mitigation would be accomplished through an interagency work group with participation of FWS and CDFG. Marsh components would be in place prior to lining the canal downstream from Drop 3, and plans for establishing riparian vegetation would be approved by FWS and CDFG.

Table III-8.—Seepage wetlands mitigation for Drop 4 Alternative [1]

	Change from existing			Mitigation		
Vegetation	Area (acres)	Percent	Habitat value (units)	Area (acres)	Percent	Habitat value (units)
Marsh	-112	100	NA	112	NA	NA
Riparian	-1,376	98	-7,398	[2]369	95	7,749
Canal bank[3]	-30	100	NA	30	NA	630
Totals	-1,518		-7,398	511		8,379

NA: Not applicable.

[1] Assumes implementation of mitigation in-place, and includes mitigation for canal bank vegetation and Drops 2 to 3 wetlands vegetation.

[2] Assumes riparian mitigation will be accomplished through creation of highest valued cottonwood/willow and honey mesquite structure types with an average habitat value of 21 units per acre.

[3] No habitat values were assigned to the canal bank vegetation. Mitigation based on acre-for-acre replacement of common reed with riparian mitigation species pursuant to FWS recommendation.

Unlike mitigation for the Parallel Canal Alternative, the mitigation plan for Drop 4 Alternative would require a management plan and identification of an agency to actively manage the created wetlands complex. The nature of extensive vegetation establishment would require more continued attention to the plantings themselves and to water delivery systems.

During the formulation of the wetlands mitigation plan, two other sites were also considered for the new equal value wetlands complex.

East Highline Site—This site would be approximately 2 miles northwest of Drop 4. Part or all of the water to support the new wetlands would come from ground water.

This site would be adjacent to scattered wetlands vegetation north of the canal. An apparent advantage of this site over the site of the existing wetlands complex is that a high ground-water table under part of the area may be able to sustain marsh vegetation in manmade depressions. If this could be relied upon, the ground water used could decrease the amount of canal water needed for mitigation, which would increase the project yield. A relative disadvantage would be that the site would be more accessible to human disturbance.

There are uncertainties as to whether the use of the ground water at the site would affect existing wetlands vegetation and/or increase seepage downstream from Drop 4. The ground water was not investigated sufficiently to determine whether it could be used without adverse effect. Pending such a determination, site preference continues to be the existing wetlands complex with its demonstrated suitability.

Drop 3 Site—This site would be immediately south of AAC Drop 3. Water would be delivered from the AAC.

Advantages of this site over the site of the existing wetlands complex are that: (1) much of this site has previously been disturbed by clearing and leveling for agricultural development (abandoned), and (2) construction activities would not have to contend with wet surface soils. These advantages did not outweigh the preference for the site of the existing wetlands complex with its demonstrated suitability.

Well Field Alternative

This alternative would not affect the wetlands habitat along the AAC.

No Action Alternative

The canal would not be lined; seepage would continue at its present rate and would support current vegetation communities; canal bank vegetation would not be removed; and canal operation and maintenance would not change from the present. It is assumed that the future without the project condition of the seepage-induced wetlands would remain unchanged from the current conditions. The no-change scenario is based on the simplistic assumption that the present mosaic of wetlands vegetation is in equilibrium with the seepage-induced, shallow ground water.

Gradual change can be expected over the 50-year period of analysis, however, as natural vegetation succession routinely occurs. There is also some evidence that the present ground-water and vegetation regime is concentrating salts in the surface

soils between Drops 3 and 4. This could gradually cause the vegetation to age and decline in foliage density. Thus, the assumption of no change without the project is believed to be conservative in favor of the wetlands.

WETLANDS HABITAT ALONG THE COLORADO RIVER

The proposed construction would conform to applicable Federal, State, and local flood plain and wetland protection standards.

Executive Order No. 11988, Floodplain Management, is concerned with minimizing flood damages by regulating development in a flood plain. None of the construction considered in this environmental impact statement/environmental impact report would be located within a flood plain or lead to development in a flood plain.

Executive Order No. 11990, Protection of Wetlands, is concerned with protection of wetlands from construction and development activities. Impacts to wetlands, together with proposed mitigation measures, are discussed under "Wetlands Habitat along the All-American Canal."

Affected Environment

Beginning about halfway between Blythe and the Imperial Dam, the Colorado River changes from being extensively channelized to having an irregular channel with numerous backwaters on the flood plain. Here the dominant vegetation of cattails and reeds creates a substantial band of vegetation around the backwaters. Beyond that area, proceeding away from the river, are substantial areas of salt cedar with screwbean and honey mesquite. Scattered stands of cottonwoods and willows are also present.

The wetlands along the river are host to a variety of wildlife, including the federally endangered Yuma clapper rail. Attachment B presents a more detailed description of special status species.

Parallel Canal Alternative

The reduction in flow in the Colorado River would reduce open water in the backwaters along the river. As described under "Surface Water," the level of the river would be lowered by one-half inch. As a maximum probable impact, the water area of the backwaters would be reduced by 4-1/2 acres, or one-tenth of 1 percent.

If such a change were to occur in a static body of water, the bankline vegetation of cattails and reeds would progress towards the new water's edge. However, the changes predicted along this river would only occur part of the time, against a background of continually changing flows and channel conditions. The minimum riverflow and periodic floodflows would not change. Consequently, there is no clear indication of impact on bankline vegetation or wetlands habitat.

To ensure that the project does not cause an adverse change to wetlands along the Colorado River, future habitat restoration work along the river would include $100,000 on behalf of the project to improve a backwater along the lower river. Reclamation, in cooperation with the Lower Colorado River Workgroup Backwaters Committee, is planning several backwater restoration or enlargement projects along the river. Money identified above as mitigation for the AAC lining would be used as part of such an improvement project.

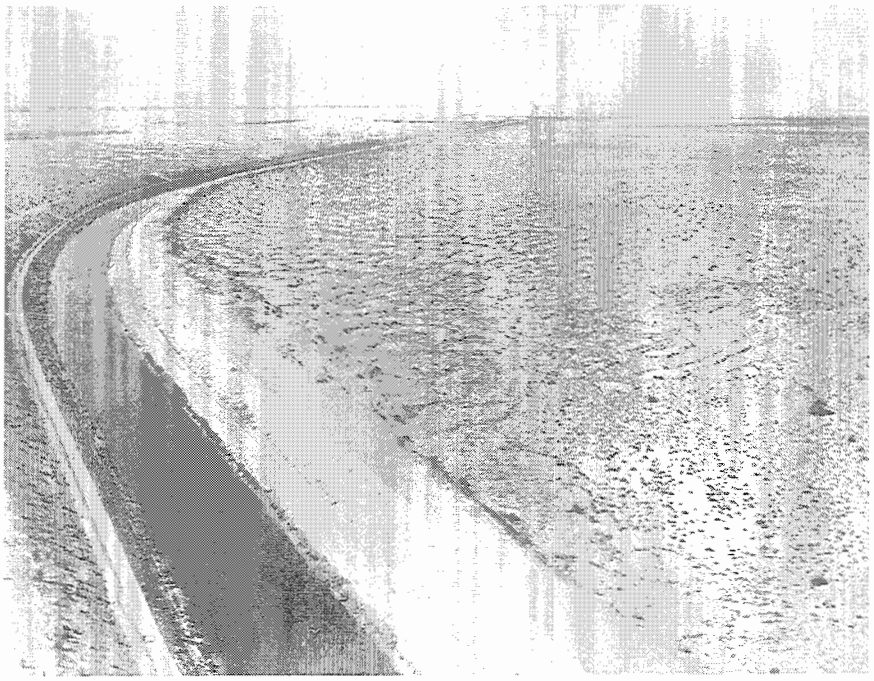


Photo 6.—Looking northwest, view shows the All-American Canal 2 miles west of Pilot Knob. The parallel canal would lie to the right of the existing canal.

The most likely opportunity would be the restoration of Three Fingers Lake, located on the Cibola National Wildlife Refuge along the river midway between Blythe and the Imperial Dam. Channel changes of the Colorado River have permitted this former lake to turn into a cattail marsh. The details of the activities would be developed by the Lower Colorado River Workgroup Backwaters Committee and coordinated with the biological work group during the project design phase. The restoration project would not result in additional consumptive use of Colorado River water.

Drop 3 Alternative

Same as Parallel Canal Alternative.

Drop 4 Alternative

Same as Parallel Canal Alternative.

Well Field Alternative

Same as Parallel Canal Alternative.

No Action Alternative

This alternative would not affect the wetlands habitat along the Colorado River.

TERRESTRIAL HABITAT

The project area is located in the lower Colorado River subdivision of the Sonoran Desert. This is the hottest and driest desert in the Southwest which greatly

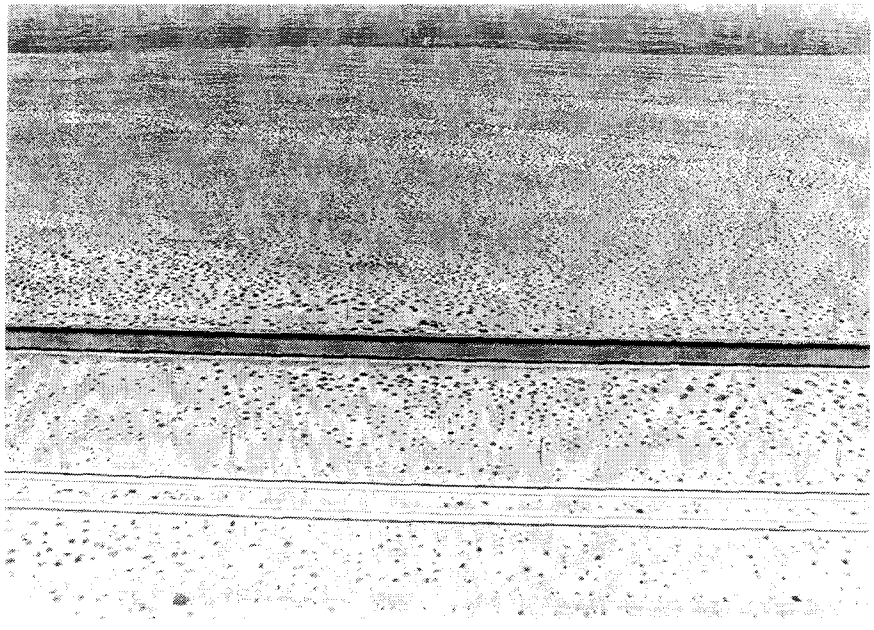


Photo 7.—Looking south, view shows the All-American Canal between Drops 1 and 2. International boundary runs through center of photograph, approximately parallel to the canal. Mexicali Valley of Mexico is in the background, and Interstate 8 is in the foreground.

influences the distribution and adaptations of the plant and wildlife communities.

Affected Environment

Terrain along the eastern 1.5 miles of the canal near Pilot Knob is characterized as an area of desert pavement intersected by desert washes. This area gradually intergrades into the Sand Hills system to the west. The canal runs along the eastern edge of rather low sand dunes for 5.5 miles before crossing the main axis of the Sand Hills near Interstate 8 (I-8). At this point, the sand dunes are encroaching on the canal from the north. On the south side of the canal is a flat gravelly area. The next 16.5 miles of the project area is relatively flat desert scrub with some areas of small sand dunes and sand hummocks. The western 3.2 miles transects a mixture of desert scrub and wetlands.

A number of plant species have become established on the berms and canal banks. Within the Sand Hills, vegetation on the berms is characteristic of the sand dunes, especially on the north (windward) side. Elsewhere along the canal, plants

associated with creosotebush are common. Marsh plants occur in thin bands near the canal water edge.

The four terrestrial plant communities represented are creosotebush scrub, wash woodland, sand dune, and wetlands communities. The following sections briefly describe the significant biological characteristics of the first three plant communities.

Creosotebush Scrub Community

This community represents the most extensive habitat type found in the Mojave and Sonoran Deserts. The two dominant plants in this community, creosotebush and white bursage, are very common. Due to competition for scarce soil moisture, plant growth is typically open and simple. Total plant cover ranges from 25 to 50 percent.

The creosotebush scrub community supports a surprisingly diverse association of wildlife species adapted to the arid conditions. Existing literature indicates some 63 bird species, 47 mammal species, 29 species of reptiles, and 7 species of amphibians have been recorded in the general project area. There is much information documenting the species occurrence and densities of vertebrate species in desert scrub communities in the general desert Southwest and specific project area.

Wash Woodland Community

This community, also referred to as macrophyll woodland, occupies wash channels and low pockets where intermittent flows and higher soil moisture support more diverse and structurally complex vegetation. Small microphyllous (small-leaved trees) are common and include blue palo verde, desert willow, ironwood, and smoke tree.

This community supports more abundant and diverse wildlife populations due to a more complex vegetative and soil structure. Many species of breeding and migrating birds especially favor these areas. Most species in the creosotebush community occur here as well as those associated with microphyll trees and desert washes.

Sand Dune Community

Sand substrates are common throughout the lower Colorado River desert subdivision. Between Pilot Knob and Drop 1 for a distance of about 8 miles, the AAC crosses the Sand Hills, which is the largest and most famous dune system in the area. The area is characteristic of actively moving and partially stabilized sand dunes with a sparse but unique plant community. Plant species occurring on the dunes include giant Spanish needle, desert buckwheat, sand food, and Wiggin's croton. Peirson's milkvetch and silver-leaved dune sunflower also are found in the dunes, along with many annual plants, in years of optimal rainfall and temperatures.

Many of the plant species have limited distribution or are native to the area. A more indepth discussion of the sensitive plant species is found in "Special Status Species."

The sand dune habitat supports several vertebrate species adapted to the sand substrate. The Colorado desert fringe-toed lizard is an example of one that is native to the area and is only found on sand substrate.

Within the Sand Hills area, vegetation on the berms and canal banks is characteristic of the sand dunes, especially on the north (windward) side.

Parallel Canal Alternative

The 600-foot construction zone disturbance would eliminate up to an estimated 587 acres of desert scrub and 916 acres of sand dune habitat. Approximately half of this acreage would be permanently lost to the canal, access roads, and spoil deposits. The exact amount lost would depend on how close the new canal is to the old.

This acreage estimate is considered maximum probable impact. After final design of project facilities and determination of staging areas, access roads, and other uses, total acreage will be adjusted based on results of 1993 FWS habitat surveys[6] and in consultation with the interagency biological work group.

Construction also would require vehicular access roads to and along the canal and material disposal areas adjacent to the canal. To the greatest degree practical, areas previously used for such purposes (when the original canal was built) would be used. Such areas have become naturalized by weather and natural revegetation since the 1940's, although generally to lower density than originally.

Following completion of construction, work areas would be graded to blend with original ground contours. To minimize impacts, vegetation would be crushed rather than bladed whenever possible. In vegetated areas requiring blading, topsoil would be stockpiled and replaced after construction. IID and the Bureau of Land Management (BLM) would control public vehicular access to these areas to prevent their perpetuation as roads. Ultimately, wind erosion would remove traces of equipment activity, and native vegetation would reestablish itself. Observations after original canal construction and powerline construction indicate that the process of revegetation would take from 30 to 50 years, depending on topography and moisture conditions.

Prior to construction, the amount of this land providing habitat for special status species would be determined. Compensation would be provided by replacing lost habitat on an acre-for-acre basis, based on ecological equivalency.

Drop 3 Alternative

This alternative would involve construction disturbance as discussed above under "Parallel Canal Alternative." An estimated 109 acres of desert scrub vegetation would be lost to disturbance on a 50-foot-wide strip on each side of the canal. In addition, an estimated 153 acres of sand dune habitat would be lost to excavation spoil, new access roads, and canal prism widening. Essentially, all vegetation in the berms would be subject to disturbance. Burrows of animals in the berms would also be disturbed.

Mitigation for these losses would be as described for the Parallel Canal Alternative, except the acreage would be less.

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[6] U.S. Fish and Wildlife Service, 1993a. Surveys for Seven Rare Plant Species, the Flat-Tailed Horned Lizard, and the California Fringe-Toed Lizard, All-American Canal Lining Project, Ventura, California, August 1993.

Drop 4 Alternative

The impacts of and mitigation for this alternative would be similar to that under the Drop 3 Alternative, except that the construction activities would affect an additional 5.3 miles of canal. This would result in the loss of 183 acres of desert scrub and 153 acres of sand dune habitat.

Mitigation for these losses would be as described for the Parallel Canal Alternative, except the acreage would be less.

Well Field Alternative

Potential habitat disturbance would occur as the drill sites are being cleared and as the powerline is being constructed. Approximately 6 acres of land would be used for the well sites—5 desert scrub and 1 sand dune habitat.

Each drill site would be paved with gravel to accommodate drilling equipment and, ultimately, to provide for well operation and maintenance.

The wells would be situated so as to minimize reduction of desert wash habitat and creosotebush scrub habitat. The powerline route would be chosen to minimize new land disturbance by using as much previously disturbed land along the canal as possible. Lost plant life due to the construction of the well field would be allowed to revegetate itself.

Mitigation would be as described for the Parallel Canal Alternative. Portions of the drill sites cleared but not covered with gravel for operating purposes would be graded to their original shape and revegetated with native plant species. All stockpile materials and equipment would be removed from the well sites upon completion of work.

A vegetation monitoring program would be included in the operation and maintenance program for the project to check for changes related to changes in ground-water depth. This would be done in conjunction with the monitoring of ground-water levels, by means of project observation wells.

No Action Alternative

Without the project, no change would occur in terrestrial habitat.

SPECIAL STATUS SPECIES

Affected Environment

Twenty-five sensitive, unique, and protected plant and animal species (table III-9) may occur in the project area. The marsh/wetlands complex between Drops 3 and 4 of the AAC is occupied by the federally endangered Yuma clapper rail. Approximately 111 acres of suitable marsh habitat exists in this area. Suitable habitat continues west of Drop 4 (outside the project area) to approximately the turnout of the East Highline Canal. Based on field inspections, the 1 acre of marsh between Drops 2 and 3 was determined to be unsuitable Yuma clapper rail habitat. Candidate bird species, which have potential for Federal listing and may occasionally use the wetlands habitat, include the white-faced ibis, fulvous whistling duck, and tricolored blackbird. All of these species are distributed over a wide geographical area.

Habitat for the flat-tailed horned lizard occurs throughout most of the project area except for the seep wetlands and the most active section of the Sand Hills. Habitat for the Colorado desert fringe-toed lizard, the Andrew's dune scarab beetle, and three

Table III-9.—Summary of impacts on special status species from the Parallel Canal Alternative

Listed species	Potential impacts	Impact avoidance
Endangered Species		
Yuma clapper rail	Impact unlikely.	None required.
Candidate Species		
Mexican long-tongued bat, California leaf-nosed bat, Southwestern cave myotis, Spotted bat, Greater mastiff bat, and Occult bat	Impacts unlikely. Few individuals in a large area.	None required.
California black rail	Impact unlikely.	None required.
White-faced ibis, Fulvous whistling duck, Swainson's hawk, Ferruginous hawk, Western snowy plover, Mountain plover, Long-billed curlew, Tricolored blackbird, and Large-billed savannah sparrow	Impacts unlikely. Few individuals in a large area.	None required.
Flat-tailed horned lizard and Colorado desert fringe-toed lizard	Construction impacts likely.	Preconstruction surveys to avoid habitat where possible. Habitat replacement on an acre-for-acre basis.
Silver-leaved dune sunflower, Giant Spanish needles, Peirson's milkvetch, Wiggin's croton, and Sand food	Construction impacts likely.	Preconstruction surveys to avoid habitat where possible. Habitat replacement on an acre-for-acre basis.
Andrew's dune scarab beetle	Construction impacts likely.	Preconstruction surveys to avoid habitat where possible. Habitat replacement on an acre-for-acre basis.

species of candidate plant species occurs within the main section of the Sand Hills, where construction-related impacts are likely. Attachment B presents a more detailed description of the 25 special status species.

Parallel Canal Alternative

Impacts to candidate species from this alternative would involve loss of sand dune and desert scrub habitat within a worst-case, 600-foot-wide construction zone roughly paralleling the existing AAC between Pilot Knob and Drop 3.
Table III-9 summarizes impacts to special status species caused by the parallel canal under this condition. Table III-10 presents the habitat disturbances expected by implementing this alternative.

The acreage to be disturbed includes land from which the habitat would be permanently lost (canal, operating road, and spoil piles), and land on which the habitat would be disturbed long term (construction access and equipment areas).

Special Status Species Habitat

To compensate for the amount of habitat permanently lost and disturbed long term, Reclamation or the project sponsors would acquire replacement land in the project area on an acre-for-acre basis. The selection of replacement lands would be based on its ecological equivalence to the lands lost. The delineation of habitats and the suitability of replacement lands will be determined in consultation with the biological work group.

Table III-10.—Estimated quantity of habitat losses for listed and candidate species without mitigation

Habitat and associated sensitive species	Parallel Canal Alternative (acres)	Drop 3 Alternative (acres)	Drop 4 Alternative (acres)	Well Field Alternative (acres)
MARSH				
Yuma clapper rail	[1]1	[2]1	[2]112	—
California black rail				
Candidate bird species				
Candidate bat species				
RIPARIAN				
Candidate bird species	[1]99	[2]99	[2]1,358	—
Candidate bat species				
CANAL BANK VEGETATION				
Candidate bird species	24	24	30	—
DESERT SCRUB				
Flat-tailed horned lizard	[1 4]587	[3 4]134	[3 4]178	5
SAND DUNE				
Colorado fringe-toed lizard	[1]916	[3]153	[3]153	1
Andrew's dune scarab beetle				
Candidate plant species				

[1] Acreage of loss of habitat within the 600-foot construction zone (maximum probable impact).
[2] Acreage of loss of habitat resulting from cessation of canal leakage.
[3] Acreage of disturbed habitat based on 50 feet of spoils on each canal side.
[4] Includes 25 acres for contractor temporary staging area.

Flat-Tailed Horned Lizard Habitat

Acquisition of lands to replace flat-tailed horned lizard habitat would be prioritized as follows: lands in the vicinity of the AAC, other lands in the East Mesa, West Mesa, or the Yuha Basin areas of Imperial County. These acquisitions will be in accordance with BLM's Flat-Tailed Horned Lizard Management Plan. The lands acquired would be transferred to BLM for management for the protection and benefit of the species.

Sand Dune Habitat

For loss of sand dune habitats which are utilized by other special status plants and animal species, lands would be acquired within the Algodones Dunes area and transferred to BLM.

Prior to construction, abundance and habitat characterization studies would be conducted for Pierson's milkvetch, sand food, Wiggins croton, and silver-leaved dune sunflower plants in the area that could be disturbed by project activities.

If sufficient lands are not available for acquisition to achieve an acre-for-acre replacement, Reclamation or the project sponsors would fund a multispecies conservation plan for the sand dune species. Funding also will be provided for implementation of the conservation plan to equal the estimated cost of acquiring sufficient lands to meet the acre-for-acre replacement requirement minus the cost of developing the conservation plan and the cost of lands actually acquired and transferred to BLM.

To the extent possible, construction of staging areas and the batch plant would be limited to previously disturbed areas and would avoid areas where individuals of these species are relatively numerous. Qualified biologists from Reclamation, FWS, and CDFG would accompany the responsible engineers and/or contractors onsite to recommend areas to be used as borrow, disposal, and equipment staging areas.

Terrestrial habitat for the candidate species associated with blow-sand habitat would be surveyed prior to construction of staging areas and the batch plant. To the extent possible, construction of these facilities would be limited to previously disturbed areas and would avoid areas where individuals of these species are relatively numerous. The blow-sand habitat along the new canal would be expected to recover within a few years after the completion of construction, and the species of concern are expected to recolonize the area.

The Parallel Canal Alternative would avoid disturbing the wetlands complex between Drops 3 and 4, and thus would not affect the habitat of most special status species, particularly the federally endangered Yuma clapper rail. Minor impacts of construction activities on wetlands would be compensated as discussed under "Wetlands Habitat Along the All-American Canal," Parallel Canal Alternative mitigation section.

Drop 3 Alternative

Impacts to species associated with sand dune and desert scrub habitat would be similar in nature but less than under the Parallel Canal Alternative. The terrestrial disturbance for this alternative is described under "Terrestrial Habitat." Unlike the

Parallel Canal Alternative, this alternative would involve immediate removal of the canal bank wetlands vegetation.

Table III-10 presented habitat disturbances caused by this alternative. The relationship of this alternative to wetlands species would be similar to the Parallel Canal Alternative.

Drop 4 Alternative

Seepage reductions due to canal lining would eliminate all of the 112 acres of available marsh vegetation in the wetlands along the canal.

Without mitigation, the federally endangered Yuma clapper rail would likely be impacted by loss of the marsh habitat. Candidate bird species that could be impacted include California black rail, white-faced ibis, fulvous whistling duck, and tricolored blackbird. Impacts to the latter three species would probably be insignificant due to the casual nature of their occurrence.

The mitigation plan described under "Wetlands Habitat" for this alternative would prevent reduction of habitat value for these species. This habitat for both the Yuma clapper rail and California black rail would be fully in place prior to the disturbance of the marsh vegetation.

Well Field Alternative

This alternative would have no impact on habitat of species that depend on wetlands habitat or species that depend on dune sand.

A few acres of flat-tailed horned lizard habitat or sensitive plant species habitat might be eliminated by development of the well sites or disturbed by powerline construction. To minimize this potential impact, a team of biologists representing FWS, CDFG, and BLM would assist project designers in evaluating well sites. Site inspections would be done in April or May to permit identification of sensitive plant species. Impacts to terrestrial special status species habitats would be mitigated for as described under the Parallel Canal Alternative.

No Action Alternative

Under this alternative, wetlands and desert habitat along the canal used by special status species would remain as at present. However, some decline in wetlands habitat is possible as discussed above at the end of the section, "Wetlands Habitat Along the All-American Canal."

Endangered Species Consultation (Section 7 Consultation)

In compliance with the Federal Endangered Species Act, Reclamation discussed whether this project would threaten the federally endangered Yuma clapper rail and, to a lesser extent, other special status species with FWS. FWS concluded that because this alternative would not dry up the wetlands complex between Drops 3 and 4, formal consultation would not be needed for effects along the AAC (attachment E). Ground-water elevation shall be monitored within the wetland between Drops 3 and 4. If ground-water elevation decreases as a result of the project, Reclamation or the project sponsors shall initiate discussions with the sponsors and FWS to identify and implement reasonable measures to ensure

maintenance of existing values within the wetland. Special attention shall be given to maintenance of Yuma clapper rail and black rail habitat. However, if it appears the project may affect the rail habitat, section 7 consultation would be initiated. Also, if the flat-tailed horned lizard or Pierson's milkvetch is listed prior to completion of the project, consultation would be required on those species.

LARGE MAMMAL ESCAPE

Affected Environment

Canals typically transect normal movement patterns of wildlife and, in the desert environment, attract wildlife as a drinking water source. There are no documented populations of mule deer in the AAC project area. However, there is an estimated population of 300 burro deer in adjacent portions of the Chocolate Mountains about 25 miles north of the AAC. Deer may occasionally visit the AAC.

Parallel Canal Alternative

The parallel canal would have 1-1/2:1 concrete sideslope and faster velocities than the present canal. These conditions could pose a severe drowning risk to large mammals attempting to drink from the canal or cross it. FWS and CDFG are concerned about this remote hazard to mule deer and to other wildlife associated with the desert environment. Both agencies recommend inclusion of wildlife escape measures east of the Sand Hills.

Two types of measures for wildlife escape could be used for the parallel lined canal. A standard method would be to construct escape ramps on the sidewalls of the canal at intervals of 1,000 feet or more along the canal. Because of the spacing, wildlife would be exposed to fatigue and injury attempting to escape while floating between ramps. Deflector cables might be needed to channel swimming wildlife to the ramp.

A newer method would be to slipform ridges while placing the concrete lining.[7] The ridges typically would be placed at 18-inch intervals on both sides of the canal and protrude 1-1/2 inches from the canal sideslope (figure III-2). Deflector cables will be added upstream from each drop structure to channel swimming wildlife to the sides of the canal.

Such escape ridges were included on a section of the Coachella Canal as part of the Coachella Canal Prototype Lining Project. Wildlife biologists from CDFG and Reclamation tested the effectiveness of those escape ridges in 1989 by leading a live, tame mule deer into the canal. The mule deer was able to walk down the side of the canal, drink without slipping into the water, and calmly walk out of the canal. The canal sideslope was 2-1/2:1, and the test showed the escape ridges to be very effective for safe wildlife entry and exit at that slope (White, 1989).

The slipformed escape ridges are proposed for both sides along the entire length of the parallel canal. The ridges would begin 9 inches from the top edge of the lining and end below the low canal operating water

[7] This method was originally suggested by Desert Wildlife Unlimited, a local Imperial Valley wildlife group.

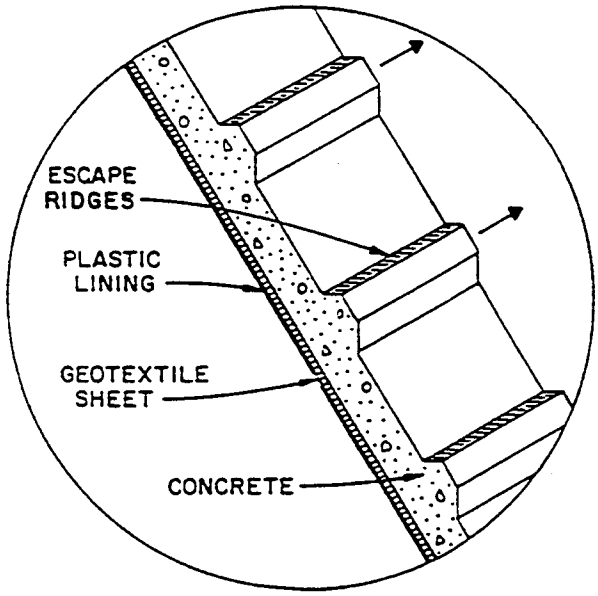

Figure III-2.—Escape ridges.

level. The effect of this proposal on public safety is discussed later in this chapter under "Public Safety."

Because the sideslope proposed for the parallel canal would be steeper than that tested, the ridges cannot automatically be assumed to be as effective for wildlife as on the flatter slope tested. However, the low probability of deer and other large mammals along the canal makes this provision a reasonable choice, considering benefits to smaller wildlife, which would not be accommodated as well by widely spaced escape ramps.

Drop 3 Alternative

The concrete layer of the proposed in-place lining would have a slope of 2-1/2:1. This is a much flatter slope than the 1-1/2:1 slope usually used for a concrete-lined canal. However, when wet and coated with silt and aquatic vegetation, the slope would become slippery and could lead to drowning of large mammals and other wildlife.

To prevent drownings, the in-place lining would incorporate the escape ridges discussed under the Parallel Canal Alternative. The escape ridges would run on both sides along the entire length of the canal. The ridges would be placed at 18-inch intervals beginning 9 inches from the top edge of the lining and ending below the low canal operating water level and would protrude 1-1/2 inches from the canal sideslope. The effect of this proposal on public safety is discussed later.

Drop 4 Alternative

The impacts and mitigation for this alternative would be the same as for the Drop 3 Alternative.

Well Field Alternative

Under this alternative, the shape and vegetation cover of the canal bank would remain as at present.

No Action Alternative

Under this alternative, the shape and vegetation cover of the canal bank would remain as at present.

CANAL FISHERY

The water surface area in the study area is 664 acres. The AAC supports game and nongamefish populations from three sources—migration from the Colorado River, natural reproduction in the canal, and in the past, CDFG stocking of channel catfish.

During the low-flow winter period of January and February, the AAC mid-channel water velocities range from 0.5 to 1 foot per second (ft/s); in the high-flow period of March through August, velocities increase to about 2.5 to 3.5 ft/s. Water velocities are lower near canal banks at all flow rates as a matter of basic hydraulics. But the shoreline vegetation and irregular channel shape reduce shoreline velocity further. Water level in the canal is generally kept at the maximum so as to maximize power generation along the canal.

Affected Environment

The fish population and species composition were estimated from information obtained when the first 49 miles of the adjacent Coachella Canal were relocated (Reclamation, 1987).

Between Pilot Knob and Drop 4, there are an estimated 284,738 fishes at a total average density of about 430 fish per acre. The fishery in the AAC is dominated by channel catfish. The next most numerous fish in the canal is the threadfin shad, a forage fish. Shoreline gamefish (largemouth bass, sunfish, and flathead catfish) comprise a very minor proportion of the fishery. Other fishes in the canal are common carp and striped bass. The common carp constitutes less than 2 percent of the total fish numbers, but because of large individual size, they compose 30 percent of the total biomass.

The relative proportions of the fish species (table III-11) reflect both the availability of different habitats and past stocking of the canal fishery.

IID plans to introduce triploid grass carp[8] into the AAC reaches proposed for lining. The carp, which feed on aquatic plants, are used to control vegetation that interferes with operation of the irrigation water distribution system. In the AAC, the carp will be added in numbers designed to maintain aquatic vegetation at a reduced density (Beaty et al., 1985).

The AAC fish population is associated with three aquatic habitat types—channel, shoreline, and drop habitats—which are defined below. Of the three habitat types, drop habitat has the highest fish density followed by shoreline and channel. Channel catfish is the only species that is found in all three habitats in roughly equal densities. Table III-12 presents the habitat areas and table III-13 the fish densities per acre.

[8] An Asiatic species of carp (*Ctenopharynogodon idella* Val.) that is herbivorous. The fish being stocked have been reared from eggs by IID in a way that causes them to be sterile to avoid proliferation of an exotic species.

Table III-11.—All-American Canal existing fishery
Pilot Knob to Drop 4

Species	Estimated numbers	Species composition (percent)	Biomass (pounds)	Biomass composition (percent)
Channel catfish	258,464	90	40,920	61
Threadfin shad	10,706	4	1,023	2
Shoreline gamefish[1]	10,851	4	4,456	7
Common carp	4,575	2	19,910	30
Striped bass	142	trace	22	trace
Total	284,738		66,331	

[1] Largemouth bass, sunfish, and flathead catfish.

Table III-12.—Surface area of fish habitat types
Pilot Knob to Drop 4

	Surface area (acres) of habitat			
	Drop	Shoreline	Channel	Total
Existing/No Action Alternative				
Unlined to Drop 4	6.3	351.0	306.7	664.0
Action alternatives				
Parallel Canal	6.3	82.4	398.1	486.8
Drop 3	6.3	63.4	594.3	664.0
Drop 4	6.3	[1]0	657.7	664.0

[1] Shoreline habitat for lined portions of the canal would not exist due to the anticipated scarcity of shoreline vegetation.

Table III-13.—Species composition and density of fishery by habitat type[1]

	Drop habitat[2]		Shoreline habitat[3]		Channel habitat[4]	
	Species composition (percent)	Density (fish/acre)	Species composition (percent)	Density (fish/acres)	Species composition (percent)	Density (fish/acres)
Largemouth bass	2.4	53.5	2.4	9.8	trace	trace
Sunfish	3.8	89.3	2.2	12.6	0	0
Flathead catfish	0.3	6.1	1.3	5.5	0	0
Channel catfish	21.6	485.5	91.6	434.8	96.3	335.7
Common carp	3.2	71.2	2.5	9.1	1.1	3.1
Threadfin shad	65.5	1,472.9	0.2	1.0	1.2	3.4
Striped bass	0	0	trace	0.4	0	0

[1] Bureau of Reclamation, 1987.
[2] Minckley et al., for an unlined section of the Coachella Canal.
[3] Minckley et al., 1983; Beaty et al., 1984; for unlined sections of the Coachella Canal.
[4] Reclamation, 1987, for a concrete-lined section of the Coachella Canal.

Channel Habitat

Channel habitat is located in the center of the canal and is characterized by higher water velocities, a shifting sand bottom, and a lack of large aquatic plants and aquatic invertebrates.

Shoreline Habitat

Shoreline habitat is characterized by lower water velocities, emergent and submerged aquatic vegetation, and aquatic invertebrates. The most common emergent plants are common reed and, to a lesser extent, cattail. The shallow areas along the canal bank have greater accumulations of silty clays and organic materials. Submerged aquatic vegetation in the canal essentially is limited to the non-native Eurasian water-milfoil, with some sago pondweed intermixed, which grows in dense bands approximately 4-1/2 feet wide at the base of the emergent canal bank vegetation. The noxious aquatic weed hydrilla, although in the AAC farther downstream, is not present in the study area.

The lower water velocities and vegetation cover provide feeding, resting areas, and shelter for fish. Shoreline habitat was considered to extend about 50 feet from the water's edge towards the middle of the canal. There are 351 acres of shoreline habitat in the study area. The shoreline habitat is considered to be the most biologically important habitat type in the AAC.

Mollusks are found in the shoreline habitat; the most common are aquatic snail and exotic asiatic clam. Limited numbers of crayfish also are found in the shoreline habitat. Emergent macrophytes also provide suitable habitat for aquatic insect larvae, but the habitat is limited in both size and diversity.

Drop Habitat

The AAC drop habitat is located below the three drop structures. Drop habitat is deeper than the channel habitat and is more likely to have a rocky bottom because of the placement of riprap near the

powerhouse discharges. In addition, there is more water turbulence in drop habitat than in other habitats. Drop structures also act as barriers to the upstream movement of fish, so fish congregate there. Drop habitat is considered to extend about 525 feet downstream from the drop structures. There are about 6 acres of this habitat in the study area.

Parallel Canal Alternative

This alternative would reduce the total area of aquatic habitat by 27 percent. In total, there would remain about 82 acres of shoreline habitat, 398 acres of channel habitat, and 6.3 acres of drop habitat in the study area. Water velocities would generally increase by about 3 ft/s.

Without mitigation, and not counting possible changes being caused by the introduction of grass carp, this alternative is estimated to reduce the total number of fish in the affected canal by about 96,000 (34.3 percent). Numerically, channel catfish would be the most affected, their numbers diminishing by about 86,000 (33 percent). Shoreline gamefish numbers would be reduced by about 7,500 fishes (70 percent). There would be less than a 1-percent reduction in number of threadfin shad and a 51-percent reduction in number of common carp.

The fish community in the study area would continue to be dominated by channel catfish (about 91 percent of the population). The estimated proportion of threadfin shad would increase from 3.8 to 6.0 percent, and shoreline gamefish would decrease from 3.8 to 1.5 percent of the total population.

Mitigation

The proposed preferred mitigation plan would be to place artificial reefs in the lined portion of the canal. These reefs would provide protective cover essential to reduce flow velocity and maintain shoreline gamefish (table III-14). Shoreline habitat is identified as the most biologically important of the three habitat types in the AAC. Shoreline gamefish are considered in this analysis to be indicator species for shoreline habitat.

However, if the artificial reefs are not as effective as estimated, two other alternate fishery mitigation plans would be considered. These plans would be to conduct a channel catfish stocking program or to develop a recreational fishery resource in one or more regulating reservoirs in IID's distribution system. The most desired mitigation would be to create habitat that would maintain the numbers of shoreline gamefish. The goal of this mitigation approach is to provide in-place and in-kind mitigation to the degree practicable. These plans were developed in consultation with FWS, CDFG, and participating water districts to conform with the policies of these resource agencies.

Artificial Reefs

A total of 197 artificial reefs would be placed in the AAC to mitigate for project impacts to fishery resources. The reefs would be made of discarded automobile tires bound together into mats. Each tire reef would measure about 16 by 50 feet and would be anchored to the canal side at a level to assure it would be submerged at all times. Current studies indicate that each reef would support 38 gamefish and 12 channel catfish. In total, artificial reefs

Table III-14.—Summary of fishery impacts and artificial reef mitigation requirements[1]

	All fish species			Shoreline gamefish species			
Alternative	Number	Change	Percent change	Number	Change	Percent change	Number of reefs needed[2]
Parallel Canal	188,830	[3](95,961)	(34.3)	3,243	(7,493)	(69.8)	197
Drop 3	247,134	(37,657)	(13.2)	2,711	(8,025)	(74.5)	211
Drop 4	238,838	(45,953)	(16.2)	943	(9,798)	(90.8)	258
Well Field	284,791	0	0	10,736	0	0	0
No Action	284,791	0	0	10,736	0	0	0

[1] Fish species numbers from the U.S. Fish and Wildlife Service, 1993.
[2] Assumes reef size approximately 16 by 50 feet and 38 shoreline gamefish per reef.
[3] Parentheses indicate negative values.

would provide habitat for an estimated 7,493 shoreline gamefish and 2,400 channel catfish. Reclamation, in cooperation with FWS, CDFG and IID, would determine the location of the reefs in the canal.

This mitigation is based upon results of the effectiveness of artificial reefs tested in the concrete-lined Coachella Canal in California and the Haydens-Rhodes Aqueduct in Arizona.

Channel Catfish Stocking

This program would be the next preferred mitigation plan. Channel catfish would be stocked at yet-to-be-determined rates which would maintain the population at preproject levels. The reason for stocking channel catfish versus other species is that, of all of the gamefish in the canal, channel catfish are the best suited for the post-lining channel habitat conditions. This mitigation plan would satisfy resource agencies for in-place mitigation and partially satisfy the in-kind criteria.

Regulating Reservoir

This mitigation option would be to improve regulating reservoirs within IID for the benefit of fishery resources. Habitat manipulation would include measures to develop and improve substrates through placement of riprap and gravel; construction of log, brush, or other material habitat structures; and establishment of emergent aquatic vegetation.

Operational provisions would be made to assure acceptable water levels in the regulating reservoir. Lastly, a stocking program would be developed and implemented. If this mitigation alternative were pursued, IID would develop the plan which

would be reviewed by an interagency group of biologists prior to implementation.

Adequacy of Mitigation

With mitigation, the Parallel Canal Alternative would result in a reduction in overall number of fish and a change in relative species abundance. However, mitigation would maintain the gamefish population in sufficient numbers to maintain recreational fishing in the study area. If modification of the planned fisheries mitigation or the development of other alternatives becomes necessary, appropriate measures will be taken in coordination with the interagency biological work group.

Drop 3 Alternative

Impact Without Mitigation

The total surface area of available aquatic habitat in the study area would remain at approximately 664 acres. Between Pilot Knob and Drop 3, shoreline habitat would be eliminated and replaced by channel habitat because of the loss of the aquatic vegetation. The area of drop habitat would not change.

The most pronounced impact of in-place lining would be the reduction or elimination of several cover-oriented fish species, such as largemouth bass, bluegill, green sunfish, longear sunfish, and flathead catfish. Although channel catfish numbers show significant reductions, their

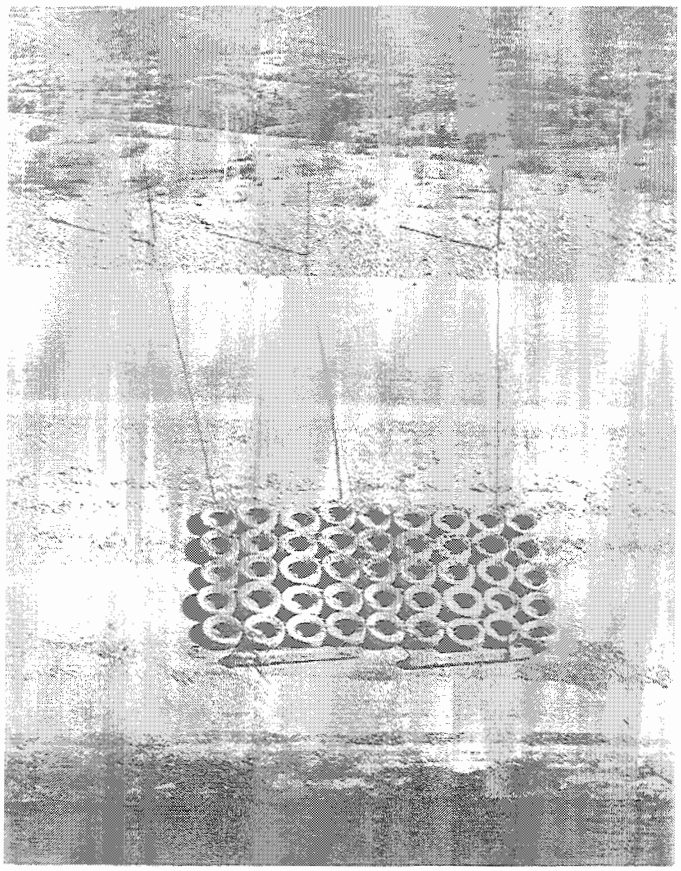

Photo 8.—View of an experimental artificial reef of scrap automobile tires in a concrete-lined canal. This reef measures about 230 square feet.

percentage of change would be low, and dominance of the channel catfish is projected to continue. Threadfin shad would be the least affected of the fish species because its association with the shoreline habitat is much less than that of other species. Table III-14 summarizes the estimated changes from the current fishery to the anticipated future fishery.

Mitigation

The mitigation for this alternative would be as described for the Parallel Canal Alternative, except that 211 artificial reefs would be used.

Adequacy of Mitigation

Same as Parallel Canal Alternative.

Drop 4 Alternative

Impact Without Mitigation

Under this alternative, the total surface area of aquatic habitat would remain at 664 acres. Because all of the canal in the study area would be lined, all 351 acres of shoreline habitat would be eliminated and replaced by channel habitat, resulting in 658 acres of channel habitat and 6 acres of drop habitat. There would be an estimated total reduction of 46,000 fish (16.2 percent) in the study area (table III-14). As with the other alternatives, channel catfish would experience the greatest numerical reduction, but only a small percentage reduction. Shoreline gamefish would be reduced by about 90 percent.

There would be an estimated 8-percent increase in numbers of threadfin shad and a 46-percent reduction in numbers of common carp. The resultant fish community in the study area would continue to be dominated by channel catfish.

Mitigation

The mitigation for this alternative would be as described for the Parallel Canal Alternative, except that 258 artificial reefs would be used.

Adequacy of Mitigation

Same as Parallel Canal Alternative.

Well Field Alternative

This alternative would not affect canal fishery. The addition of triploid grass carp to the canal to control aquatic weeds is expected to reduce the quality of shoreline habitat by an undetermined amount.

No Action Alternative

This alternative would not affect the canal fishery. The addition of triploid grass carp to the canal to control aquatic weeds is expected to reduce the quality of shoreline habitat by an undetermined amount.

CULTURAL RESOURCES

Cultural resources are buildings, sites, districts, structures, and objects significant in history, architecture, archeology, culture, or science.

Affected Environment

The AAC from Pilot Knob to Drop 4 traverses land that contains remnants of cultural activity from prehistoric to recent historic periods. The Pilot Knob area, adjacent to the AAC near Yuma, is one of the most significant and sensitive areas of cultural resources in the Colorado Desert. The entire Imperial Valley was a major prehistoric habitation area between 950 years ago, when Lake Cahuilla was created, and the last recession of the lake approximately 500 years ago. The Salton Sea presently lies at the center of Lake Cahuilla. The ancient shoreline of Lake Cahuilla is an important archeological zone because of the concentrated human activity that has occurred there over the centuries.

The types of prehistoric remains encountered along the AAC include lithic scatters (worked stones), cleared circles, rock alignments, geoglyphs,[9] rock rings, habitation sites, trails, quarry sites, cairns, and petroglyphs. Most are located at Pilot Knob.

Pilot Knob, which contains numerous and diverse archeological remains, was the focus of traditional ceremonies and symbolism for the Quechan, Cocopah, Kamia, and possibly other Native American groups. The time periods involved probably span the entire 12,000-year period of Native American occupation along the Colorado River.

Pilot Knob and parts of the gravel terraces on its south side are sacred in the religious practices of the Quechan Indian Tribe (Tribe), on whose behalf public access is restricted by BLM. BLM has established the Pilot Knob Area of Critical Environmental Concern (ACEC) along the AAC to protect archeological and Native American cultural resources at Pilot Knob (figure III-3).

A class III[10] survey was previously made adjacent to the north side of the canal at Pilot Knob, extending to approximately 1 mile west of Pilot Knob. A total of 95 sites are within or immediately adjacent to the project area. The land along the rest of the AAC is relatively rich in remains of Native American occupation, although less dense than the Pilot Knob area.

The area west of Pilot Knob has been subjected to sporadic surveys. In addition to the Pilot Knob sites, there are an additional 51 known features along the remainder of the canal right-of-way.

The area is significant because of the clear and close association between prehistoric quarry activities, habitation sites, transit corridors, and sacred sites. With local archeological data and ethnographic information, interpretations can be made about subsistence patterns, traditional ceremonies, and religious beliefs. The area is one of the few places where ethnographic data can be used to guide research into much older components, extending back over 10,000 years. The AAC itself is a potential candidate for listing in the *National Register of Historic Places*.

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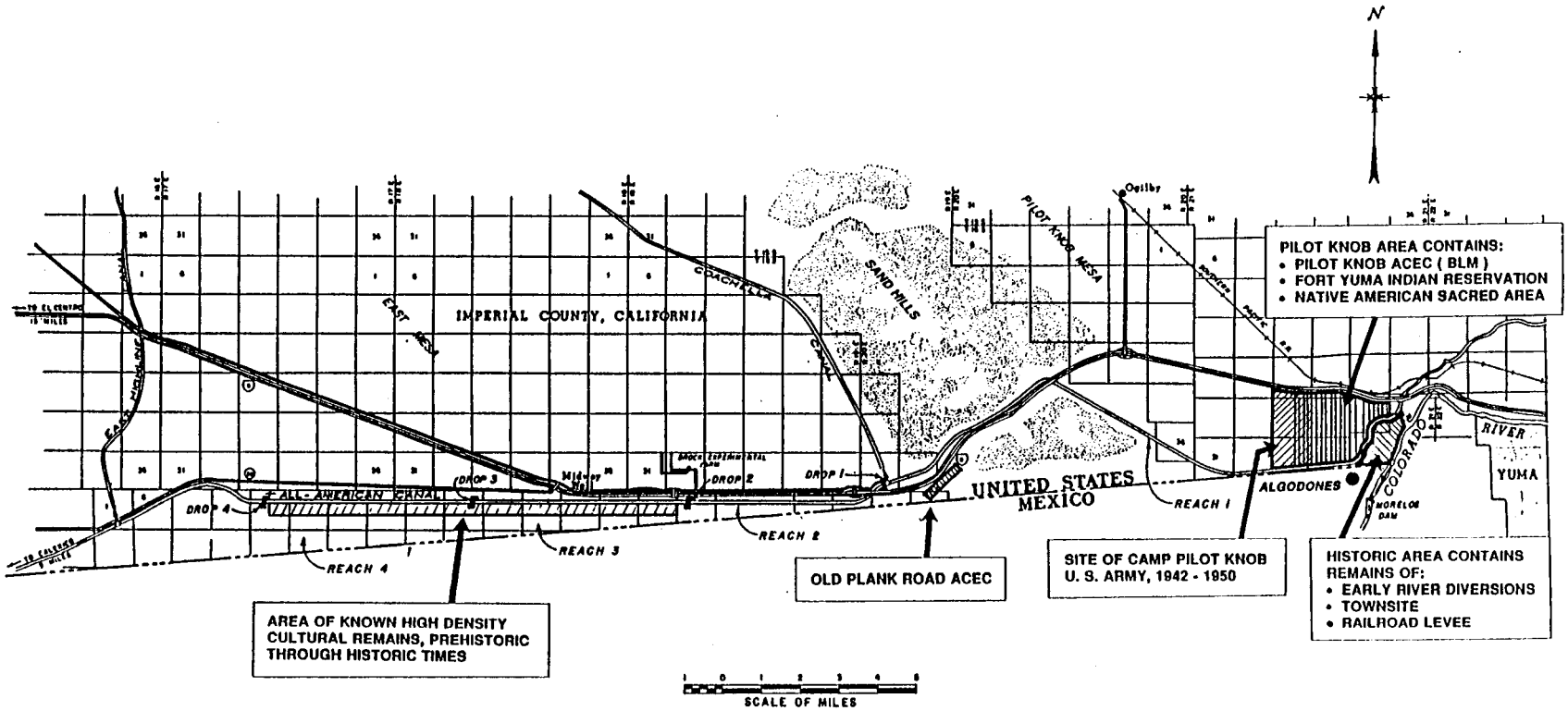
[9] Geoglyphs are large-scale designs on the surface of the ground formed by rearranging stones and/or topsoil.
[10] A class III survey consists of intensive, 100-percent, on-the-ground examination of the affected areas.



CULTURAL RESOURCES

ALL-AMERICAN CANAL LINING PROJECT
IMPERIAL COUNTY, CALIFORNIA

Figure III-3

Parallel Canal Alternative

In order to avoid the gravel terraces south of Pilot Knob, the starting point of the canal lining (point where the new canal diverges from the existing canal) would be west of Pilot Knob. Further west along the canal, the construction of a parallel canal has the potential of disturbing scattered archeological sites, including burial or cremation sites.

A long sequence of historic preservation legislation has established a Federal policy of avoiding or minimizing adverse effects upon cultural resources when planning and constructing Federal projects. However, disturbance or destruction of some cultural resources may be unavoidable if the project is to be constructed.

In those instances, two acts—the National Historic Preservation Act (NHPA) of 1966 as amended and the Reservoir Salvage Act of 1960 as amended by the Archaeological and Historical Preservation Act of 1974—require that at least some of the information embodied in those resources is retrieved prior to construction.

Prior to construction, class III surveys would be conducted in the Pilot Knob area and along the entire length of the canal to be lined to determine the locations of cultural resources. Surveys also would be conducted at gravel quarries not previously surveyed.

In case a site cannot be avoided, mitigation would include professionally recovering, documenting, and preserving the cultural

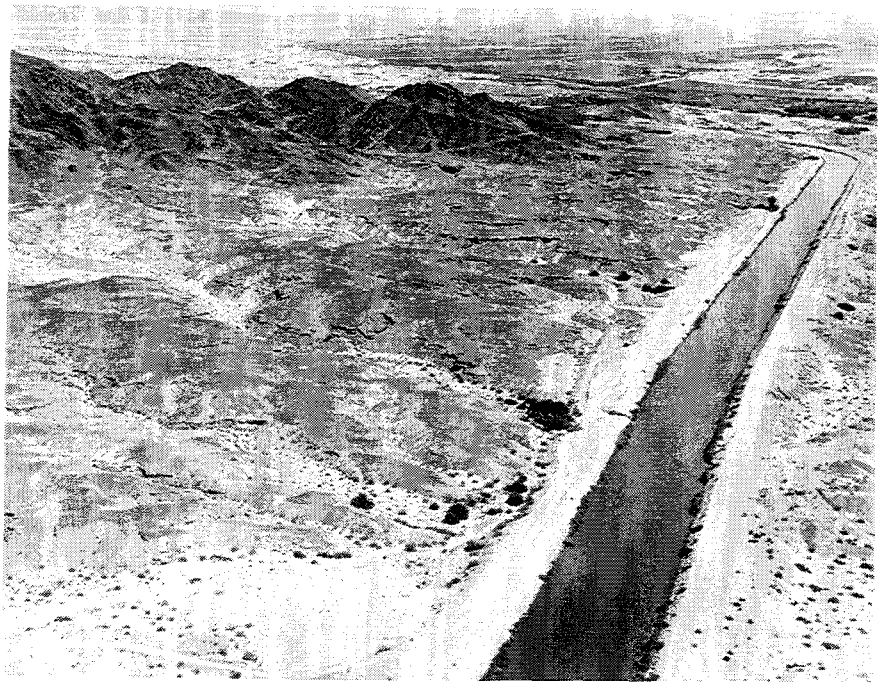


Photo 9.—View looking east shows the All-American Canal along the gravel terraces south of Pilot Knob. Upper left of photo is Pilot Knob.

resources as appropriate. Surveys and recovery activities would be coordinated with the California State Historic Preservation Officer (SHPO) and the Tribe, with whom project coordination is in progress. To fulfill the requirements of the NHPA, Reclamation will enter into an agreement with the California SHPO, Native American tribes, BLM, other interested persons, and the Advisory Council on Historic Preservation. A Native American observer would be given the opportunity to participate in archeological surveys in the Pilot Knob ACEC.

Impacts may also result from inadvertent disturbance from the influx of people residing near construction sites. Steps would be taken as part of an interim Recreation Management Plan to deter the public from sensitive areas. Incidental contractor activity at the construction site would be restricted to a predetermined area. Each onsite construction contract would include provisions requiring the contractor to report cultural resources located during the construction activities and to cease construction activities in the immediate area of the located resources until the site is inspected by professional cultural resources personnel. In the event that cultural resources are discovered during construction, work would be suspended until evaluation and mitigation are complete.

Drop 3 Alternative

Although the canal lining would begin southeast of Pilot Knob, the Pilot Knob terrace sites would be completely avoided. Construction activities along the south side of the Pilot Knob ACEC would be confined to areas that have been disturbed through previous construction and maintenance activities. While adverse to the spiritual values held by the Tribe, the Tribe is not unduly disturbed by this short-term impact considering the potential benefits of the project.

Further west along the canal, there is a potential for peripheral disturbance to cultural resources even though the lining would be confined to a disturbed strip of land.

Class III surveys and mitigation would be the same as for the Parallel Canal Alternative.

Drop 4 Alternative

The impacts and mitigation would be similar to those in the Drop 3 Alternative, but would include an additional 5-1/2 miles of canal.

Well Field Alternative

Construction of the wells would disturb 1/4-acre sites along the south side of the canal every one-fourth mile to three-fourths mile, depending on soil type, terrain, land development, and location of biological and cultural resources. In addition, the construction of a powerline would involve equipment travel and limited disturbance at power pole locations. Most or all of the land to be occupied by the well sites and the powerline has been disturbed by the construction of the AAC, so little or no disturbance of cultural resources is anticipated.

A class III survey would be made of the proposed well sites and surrounding area, and of the powerline corridor. Well sites found to contain significant cultural resources would be moved to the extent possible. Where a cultural site cannot be

avoided, mitigation would be as described under the Parallel Canal Alternative.

No Action Alternative

This alternative would not have an effect on cultural resources.

RECREATION

Imperial County is a popular recreational area for both water- and desert-based activities. Opportunities for recreation occur along the AAC and in the surrounding desert primarily under BLM auspices. The area around the AAC is a popular, seasonal, long-term camping and desert recreation area.

The peak visitor season is generally in January and February; however, November, December and March are also heavy use times for many commercial recreational vehicle (RV) parks. Vehicle types using RV parks include motor homes (42 percent), trailers (50 percent), pickups and vans (7 percent), and tents and tent trailers (1 percent).

IID permits fishing in its canals and the AAC and provides public access for angling to three of its regulating reservoirs. These recreational fishing opportunities include fish species such as channel catfish, bass, and sunfish, as described previously under "Canal Fishery."

At greater distance from the canal, the Salton Sea is a major southern California recreation area largely because of its sport fishery. Activities include fishing and hunting, camping, boating, picnicking, rock collecting, bird watching, and water sports (swimming and water skiing). Certain activities are constrained by water quality. A health advisory posted at the Salton Sea cautions against human consumption of fish caught in the Salton Sea because of selenium detected in the fish. Water contact sports are limited near the mouth of the New River, whose water constitutes a health hazard for recreation because of contamination from agricultural drains and wastewater treatment facilities in Imperial Valley and unregulated point source discharges in Mexico.

Affected Environment

BLM manages recreation on an extensive area of Federal land adjacent to the AAC, with the Sand Hills providing the greatest attraction. Recreation facilities include paved access roads, parking areas, and sanitation and trash facilities. Available facilities and camping areas generally are overcrowded during high-visitation weekends. Over a quarter of a million visitor-use-days may occur over a Thanksgiving weekend. Off-road vehicle operation in the Sand Hills is a major public attraction in the area, and off-road vehicles range over the sand dunes and adjacent areas except where restricted in special areas for safety or protection of resources.

Sand dunes abut the spoil bank along the north side of the existing canal. The sand road along the spoil bank is used by off-road vehicle operators for travel around the south end of these dunes and by BLM for patrol and emergency purposes.

BLM has plans to increase visitor facilities. The plans include improvement of access and facilities in the area along the international boundary between the vicinity of Drop 1 and the Sand Dunes interchange along I-8, about 4 miles to the east of Drop 1. Plans include a bridge over the

canal immediately downstream from the I-8 crossing at Drop 1. Figure III-4 shows the layout of current and proposed facilities in this area (Bureau of Land Management, 1987).

Three RV camping parks located around the Pilot Knob area have a total of 849 spaces, while another five located close to El Centro total 543 spaces. Of the parks surveyed, only 31 percent are open year round.

Recreational use of the 29.9-mile section of canal under consideration for lining centers on sport fishing. The fish population of the canal is described under "Canal Fishery." No data are available on fishermen use or success in this section of canal. However, it is reported that the largest fish, in terms of weight, caught in the canal system come from sections of canal above Drop 4 (Dr. Randall Stocker, personal communication).

The addition of triploid grass carp to the canal by IID is increasing the diversity of fish species from that observed in the past. This introduction is not expected to have an adverse impact on sport fishing.

Swimming is prohibited in the AAC. Dense bankline vegetation along most of the canal tends to make swimming uninviting; nonetheless, illegal aliens swim across the canal to enter the United States, particularly in the Pilot Knob area. This results in occasional drownings as discussed under "Public Safety."

Parallel Canal Alternative

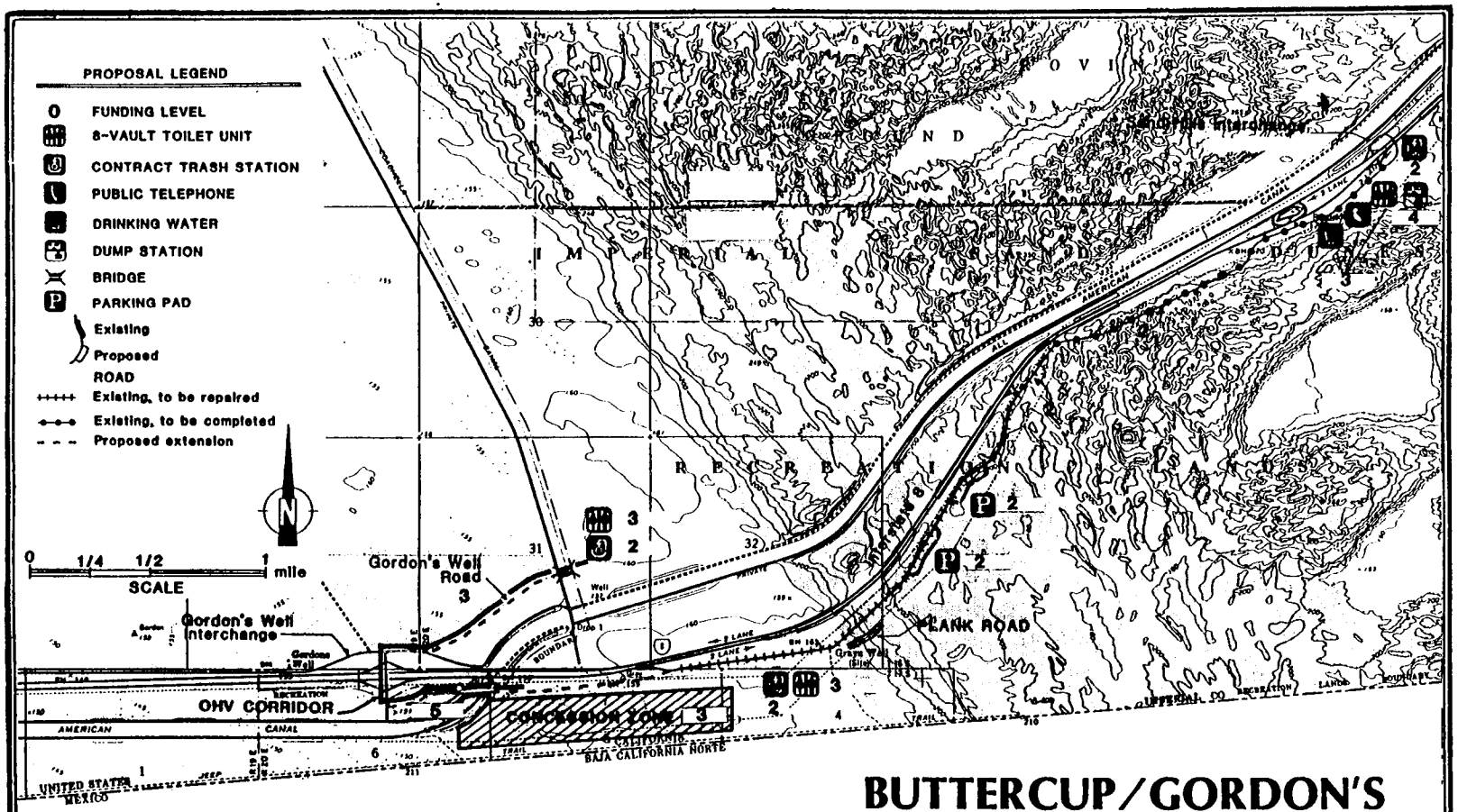
The new parallel canal would not have an adverse impact on the pattern of general recreation opportunity along the canal or elsewhere. The canal is presently a barrier to off-road travel and would continue to be so. The old canal would be maintained for use as an emergency channel and would not be available for recreational use.

Construction activities could cause minor temporary impacts to recreation along the canal. Between Pilot Knob and Drop 1, the new canal would be north of the old canal. East of the freeway crossing, some spots of disturbed desert land that have convenient access to I-8 are used by the public for camping. Such use by the contractor would not significantly reduce the opportunity for public use.

Seasonal RV camping opportunity in the Pilot Knob area would not be reduced by construction. Construction through the Sand Hills would block the use of the spoil bank road on the north side of the canal for travel around the dunes abutting the canal. This blockage would be for up to 12 months, depending on the contractor's rate of progress. After construction, the spoil bank along the north side of the new canal would again be available for travel around the south end of these dunes.

A considerable amount of random recreational all-terrain vehicle traffic occurs in the Sand Hills area. This popular spot draws thousands of these riders each year from the southern California coastal area. District 38 of the American Motorcyclist Association is bidding for the prestigious International Six-Day Enduro off-road racing event slated for 1994. This alone might draw an estimated 25,000 spectators to the Imperial Valley over the 6-day event. Careless off-road vehicle drivers, who presently cause numerous accidents, may be a problem in the construction zone, posing a risk to themselves and construction forces.

To minimize public inconvenience during construction and ensure public safety, an



BUTTERCUP/GORDON'S WELL AREA

Facility Developments

From BLM, 1987

Figure III-4

interim recreation management plan would be developed jointly with BLM. The plan would include temporary closure of acreage needed for construction activities, signs at public access points, literature (handouts) informing visitors about the program and safety hazards, and modifications of public access to compensate for construction activities and to provide safe public access to observe construction at selected locations. The plan would address the patrol and surveillance requirements of the Immigration and Naturalization Service's Border Patrol (Border Patrol).

Hazards to off-road vehicles associated with the old canal would be avoided by taking steps necessary to prohibit and discourage public use within the channel.

Without implementation of fishery mitigation measures, this alternative would adversely affect recreational fishing by reducing the numbers of gamefish in the canal reaches to be lined. Lining could also slightly reduce downstream numbers by reducing in-canal reproduction. The numbers of channel catfish in the study area would decrease by about 33 percent, and the numbers of shoreline gamefish would decrease by about 70 percent. These decreases would decrease the catch per hour of fishing by an undetermined amount. A reduced catch per hour could reduce the number of fishermen in the study area. A public perception of a decrease in quality of fishing associated with a concrete-lined canal could also reduce the number of anglers.

Proposed mitigation in the form of artificial reefs or other options discussed under "Canal Fishery" is included in the project to maintain sport fishing opportunity. The mitigation would reduce, but not totally eliminate, the adverse impact the project could have on canal fishing.

The elimination of dense canal bank vegetation and the creation of a smooth canal sideslope with escape ridges or escape ladders may induce members of the public to swim in the canal. The number of illegal aliens attempting to swim across the canal would probably not be affected.

Drop 3 Alternative

The construction period impacts of this alternative would be generally similar to those of the Parallel Canal Alternative, except that the narrower construction zone would interfere less with off-road RV travel, particularly along the north side of the canal at the Sand Hills.

The permanent effects of this alternative on general recreation would be the same as the Parallel Canal Alternative.

Drop 4 Alternative

Same as Drop 3 Alternative.

Well Field Alternative

This alternative would not have a significant impact on recreation. Drill sites would be close to the south side of the canal and would be reached from the canal maintenance road.

No Action Alternative

This alternative would have no effect on recreation.

LAND OWNERSHIP AND USE

Imperial County is the ninth largest county in California and covers an area of 4,597 square miles or 2,942,080 acres. Generalized land ownership and use is as follows:

	Percent
Irrigated agriculture	18
Developed (built up)	1
Salton Sea	7
Undeveloped Federal	50
Undeveloped private, State, and Indian reservation	24
Total	100

Affected Environment

The first 0.4 mile of the 29.9-mile section of canal being investigated lies on the Fort Yuma Indian Reservation, along a 1,000-foot-wide right-of-way for the canal. The west boundary of the Fort Yuma Indian Reservation lies on the east side of Pilot Knob. The remainder of the canal lies on Federal land previously withdrawn from the public domain for irrigation development in the Imperial Valley and for construction of the AAC.

The culturally important land on the north side of the canal at Pilot Knob lying outside of the Fort Yuma Indian Reservation has been designated by BLM as the Pilot Knob ACEC because of its archeological significance.

Parallel Canal Alternative

The parallel canal would begin downstream from the Fort Yuma Indian Reservation and the Pilot Knob ACEC. At the starting point of the new canal, construction access to the north side of the canal would be along Sidewinder Road. The canal bank road on the north side of the canal upstream from the starting point of the new canal would be used for incidental activities such as filling water trucks and launching work barges. Incidental contractor activity there would be restricted to the width of ground that is already disturbed.

The contractor would require a plot of approximately 5 acres near Pilot Knob, staging areas amounting to 25 acres or less, and plots at other locations for temporary equipment staging and concrete batching.

Construction access to the south side of the canal would be along the canal bank road on that side, approaching from the vicinity of the international border crossing at Algodones. The wide canal bank would accommodate access traffic.

The new canal would require 530 acres of land lying within the area previously withdrawn from the public domain for construction of the canal and disposal of excavated material. The project may require the acquisition of land for mitigation.

Drop 3 Alternative

The new canal would begin on the canal right-of-way within the Fort Yuma Indian Reservation. Access to the start of construction would be along Sidewinder Road. Equipment travel and construction activity on the north side of the canal along the Pilot Knob ACEC would be limited to the canal bank strip of land previously disturbed by construction and operation of the canal.

Along the first 1-1/2 miles of canal construction, soil excavated from the canal bottom during the trimming operation would be deposited in the arroyos between the canal and the international boundary, which is several hundred feet from the south canal bank. Along the remainder of the canal, excavated soil would be deposited on both sides of the canal unless it would interfere with roads or other improvements. No changes in land ownership would occur.

The contractor would require a plot of approximately 5 acres near Sidewinder Road and at other locations along the canal for temporary equipment staging and concrete batching. One such other location would be south of the canal near the international border crossing at Algodones, using available canal right-of-way and/or Fort Yuma Indian Reservation land under arrangement with the Tribe.

Drop 4 Alternative

The impacts of this alternative would be the same as for the Drop 3 Alternative but would extend 5 miles further downstream.

Well Field Alternative

The wells would be located on Federal land previously withdrawn for construction and operation of the canal.

No Action Alternative

This alternative would not have an effect on land ownership or use along the AAC.

SAND AND GRAVEL SUPPLIES

Affected Environment

Sources of sand and gravel suitable for manufacture of concrete are located near the foot of the Chocolate Mountains in the Chocolate Mountains Aerial Gunnery Range, other scattered locations in the Imperial Valley, along the Coachella Canal between Wister and Bombay Beach, and on the Fort Yuma Indian Reservation about 3 miles northeast of Pilot Knob. Quarries are in operation at the first three sources. The Tribe is interested in marketing material from the last source.

The supply of sand and gravel available for commercial use in the Imperial Valley is limited because of the content of the deposits. Deposits near the Chocolate Mountains are abundant but generally unavailable because of military operations. There is a public concern in the Imperial Valley that the proposed canal lining project would compete with local building projects for the sand and gravel supply from sources currently permitted.

Quarrying sand and gravel in the Imperial Valley is also controlled for environmental reasons. The source along the Coachella Canal lies along the shoreline of prehistoric Lake Cahuilla, a zone of land that typically contains an abundance of cultural resources. The area northeast of Pilot Knob is also in an area containing cultural resources. In addition, areas containing sand and gravel may contain terrestrial wildlife habitat of value. Development of a new gravel quarry or expansion of an existing quarry typically affects these resources.

Much of the supply is on Federal land, subject to removal only under permit from

BLM. Permitting procedures of BLM include requirements for environmental assessments where additional land is disturbed and may require mitigation.

Imperial County administers the Surface Mining and Reclamation Act of 1975 locally, which requires approved site reclamation plans for surface mining operations.

Parallel Canal Alternative

This alternative would require sand and gravel for concrete and for surfacing the canal bank road. An estimated 185,000 cubic yards of material would be needed, 85 percent of which would need to meet certification for concrete.

The effect of project sand and gravel requirements on the supply for local Imperial Valley use would depend on the degree to which material can be obtained beyond the normal haul for local use.

The specific source or sources of sand and gravel for the project have not been determined. During the project design phase, samples of sand and gravel from potential sources would be tested for suitability for project concrete. On the basis of such tests, a variety of sources would be certified for use on the project.

During the design phase, an assessment also would be made of the cultural and biological resources that may be affected by quarry activities at each certified site. Based on this assessment, potential disturbance of sensitive areas would be avoided by excluding the source, or would be mitigated in conjunction with mitigation for canal construction as described elsewhere in this chapter and in compliance with Imperial County requirements.

Environmental restrictions associated with certified sand and gravel sources would be included in the construction specifications.

The construction specifications would provide the contractor with the options of using one or more of the certified sources, or requesting certification of another source of his choosing. If the contractor were to request the use of a source not previously certified and assessed environmentally, he would be required to comply with applicable requirements.

Drop 3 Alternative

This alternative would require sand and gravel for concrete, for surfacing the canal bank road, and for filling low spots in the canal bottom. An estimated 355,000 cubic yards of material would be needed. Only half of that amount would need to meet certification for concrete manufacture. Impacts and procedures for obtaining sand and gravel would be the same as for the Parallel Canal Alternative.

Drop 4 Alternative

This alternative would require sand and gravel for concrete, for surfacing the canal bank road, and for filling low spots in the canal bottom. An estimated 535,000 cubic yards of material would be needed. Only half of that amount would need to meet certification for concrete manufacture. Impacts and procedures for obtaining sand and gravel would be the same as for the Parallel Canal Alternative.

Well Field Alternative

This alternative would require gravel for paving approximately 15 miles of canal bank road and paving part or all of each well site. An estimated 41,000 cubic yards of gravel would be needed, which would not need to meet certification for concrete manufacture. An estimated 800 cubic yards of concrete would be required for construction of wells and foundations for electrical facilities and discharge pipelines. This would require approximately 600 cubic yards of sand and gravel certified for concrete.

No Action Alternative

This alternative would not have an effect on sand and gravel supplies.

TRANSPORTATION

Affected Environment

The main east-west arterial highway in Imperial County is I-8, which provides a direct link from the Imperial Valley to Yuma. State Highway 86 presently provides a north-south connection service between I-8 at El Centro and Interstate 10 at Indio via the western shore of the Salton Sea. I-8 provides access to all structures and various other points along the AAC.

Rail service is provided by the Southern Pacific Railroad which has a main line entering the county from Yuma on the east, then heading northwest toward Indio before turning west to the Los Angeles area. Branch lines and spurs of the Southern Pacific serve other communities in the county. The Holten Interurban Railroad provides service from Holtville to El Centro.

Unpaved service roads along the canal are used for maintenance, recreational travel, and surveillance by the Border Patrol. Various jeep trails and dirt roads adjacent to the canal are used by the public for recreational travel.

Parallel Canal Alternative

The existing service road along the canal and various dirt roads would be used more extensively during construction activities by many types of vehicles. In some cases, public travel along dirt roads would be blocked briefly or slowed down. Due to the equipment on the roads, more safety hazards would also exist, and an increase in accident risk to the public could occur.

Major highways close to the canal would also carry equipment and materials to the construction site and staging areas, temporarily increasing traffic along these routes.

To minimize impact, off-highway traffic hazards to the public would be addressed by the interim recreation management plan discussed under "Recreation." For example, standard traffic controls such as signs and flagmen would be used as needed.

Drop 3 Alternative

Same as Parallel Canal Alternative.

Drop 4 Alternative

Same as Parallel Canal Alternative.

Well Field Alternative

Vehicles and equipment traveling to and from the well sites would use existing paved roads and the canal maintenance road on the south side of the canal. No significant impact to the public is anticipated. Off-highway travel by the public would be addressed by the interim recreation management plan discussed under "Recreation."

No Action Alternative

This alternative would not have an effect on transportation.

HYDROELECTRIC POWER

The project would affect hydroelectric power generation along the AAC and along the lower Colorado River.

Affected Power Systems

All-American Canal Powerplants

Drops 1, 2, 3, and 4 contain hydroelectric powerplants which generate power from the water flowing through the structures. IID operates the powerplants. Power generation fluctuates with fluctuations in canal water delivery. The canal generally is operated with the highest water level possible to maximize power production.

IID combines the power generated at drop structures with power from its thermal powerplants and from other sources and distributes it to retail customers in the Imperial and Coachella Valleys. IID generates approximately one-third of the power it delivers. The remainder is purchased from various power producers in California and other States.

Colorado River Powerplants

Along the Colorado River, water released for downstream deliveries generates power at (proceeding upstream) Parker, Davis, and Hoover Dams. The powerplants at the dams are owned and operated by Reclamation. As authorized by Congress, water regulation has a higher priority than power production in the operation of these dams.

Power generated at the powerplants is marketed by the Western Area Power Administration (Western) to utilities in Arizona, California, and Nevada. The amount of power generated fluctuates annually with fluctuations in downstream water delivery requirements.

Parallel Canal Alternative

All-American Canal Powerplants

Under this alternative, there would be a reduction in flow through the powerplants at Drops 1 and 2, which would reduce the amount of power generated[11] (table III-15). For perspective, the reduction is less than two-tenths of a percent of the total power generated by AAC water. The canal would continue to be operated with as high a water level as possible.

[11] The rationale is as follows: flow through Drop 1 would be reduced by the amount of water conserved annually between Drops 1 and 3. Similarly, flow through Drop 2 would be reduced by the amount of water conserved between Drops 2 and 3.

Table III-15.—Reduction in hydroelectric power[1]

Item	Parallel Canal Alternative	Drop 3 Alternative	Drop 4 Alternative	Well Field Alternative
AAC power loss along AAC	.22 MkWh[2]	.17 MkWh	.27 MkWh	.1 MkWh
Colorado River power loss at Parker Dam	3.5 MkWh	3.5 MkWh	3.6 MkWh	3.5 MkWh
Net loss at Hoover and Davis Dams	1.6 MkWh	1.5 MkWh	1.6 MkWh	1.6 MkWh
Total	5.3 MkWh	5.2 MkWh	5.5 MkWh	5.2 MkWh

[1] Compared to the No Action Alternative, which has no impacts.
[2] MkWh = million kilowatthours.

In order to meet its obligations to its retail customers, IID would replace the reduction in power by purchasing additional power from an outside source under an existing power purchase contract.

The Coachella Valley Water District (CVWD) is entitled to 8 percent of the proceeds from the sale of the power generated along the AAC. CVWD's entitlement currently is credited against its share of repayment costs for constructing the existing canal. The financial impact on CVWD of reduced power generation would depend on the future retail prices and operation costs. If calculated on the net proceeds in 1989, CVWD's financial impact would be several hundred dollars per year.

Reclamation is entitled to 14 percent of the proceeds from the sale of the power generated along the AAC. The amount of the entitlement is remitted to Reclamation annually. The financial impact on Reclamation of reduced power generation would depend on the future retail prices and operation costs. If calculated on the net proceeds in 1989, Reclamation's financial impact would be several hundred dollars per year.

The financial impact on IID would consist of the cost of purchasing additional power, minus the reduction in proceeds payable to CVWD and Reclamation. The dollar amount of the impact on IID would depend on the future cost of the purchased power.

Compensation to IID and CVWD for the financial impacts of reduced power generation would be contingent on negotiations with the user of the conserved water.

The reduction in power generation along the AAC would not affect the natural environment in the Imperial Valley or along the canal.

Colorado River Powerplants

The Colorado River Simulation System (a computer model) was used to estimate the effect of this alternative on Federal power generation facilities along the Colorado River. Simulations of future operation under the Parallel Canal Alternative indicated that the reduction in releases at Parker Dam would reduce future average annual power generation by approximately 0.9 percent. The simulations also indicated an insignificant increase in power generation at Davis Dam and a 0.03-percent decrease in power generation at Hoover Dam (table III-15).

The loss at Hoover Dam stems from the way the river system is operated. The average annual amounts of water passing Hoover Dam would remain unchanged. However, the project apparently would increase the spills from Hoover Dam during years when surplus water or floods occur in the river. The addition of more generating capacity at Hoover Dam, presently under study, may decrease the loss there.

The reduction in generation would decrease the total amount of hydroelectric power available to the Southwestern United States by a small amount. For perspective, the magnitude of the net power reduction at Parker, Davis, and Hoover Dams would be less than the annual fluctuation historically caused by fluctuations in downstream water requirements.

The reduction would be combined with regional power demand projections, increases of which are routinely met by expansion of power generation facilities by public and private utilities in the Southwest. Such expansion theoretically would result in additional consumption of fossil fuels and/or additional construction of hydroelectric facilities in the Western United States. However, the effects of such expansion on the natural environment would be so diffused as to be unmeasurable in terms of effect on the natural environment.

The power generated at Parker, Hoover, and Davis Dams is marketed by Western for 8.55 mills per kilowatthour (kWh). The rate is based on revenue requirements to repay the Federal investment in the power generating facilities, operate those facilities, and provide a fund for certain other Federal activities related to the Colorado River. The reduction in power generated would cause an insignificant financial impact to Western until the next periodic power rate adjustment is made by Western.

Drop 3 Alternative

This alternative would reduce hydroelectric power generation along the AAC and Colorado River the same way as the Parallel Canal Alternative but with slight differences in amount (table III-15).

Drop 4 Alternative

This alternative would reduce hydroelectric power generation along the AAC and Colorado River the same way as the Parallel Canal Alternative but with slight differences in amount. This alternative would reduce generation at Drops 1, 2, and 3 along the AAC (table III-15).

Well Field Alternative

This alternative would reduce hydropower generation at Drop 1 along the AAC by

approximately 105,000 kWh per year. This is based on the assumption that the wells downstream from Drop 1 (4 of the 25 wells) would recover 11,000 acre-feet of seepage water annually.

The reduction in hydropower generation along the Colorado River would be virtually the same as for the Parallel Canal Alternative.

No Action Alternative

This alternative would not change hydroelectric power generation along the AAC or Colorado River.

PROJECT OPERATING ENERGY REQUIREMENTS

This category involves electrical energy required to operate the project.

Parallel Canal Alternative

This alternative would not have an operating energy requirement.

Drop 3 Alternative

This alternative would not have an operating energy requirement.

Drop 4 Alternative

This alternative would not have an operating energy requirement.

Well Field Alternative

Operating of this alternative would require electrical energy to drive the well pumps. The amount of energy is estimated at 10.7 million kWh per year. This estimate is based on an assumed pump lift of 100 feet; 68,000 acre-feet per year production; and an efficiency of 65 percent.

The energy would be supplied by IID.

No Action Alternative

This alternative would not have an operating energy requirement.

PUBLIC SAFETY

Affected Environment

Public contact with the canal occurs through visitation, recreation, and illegal immigration across the international boundary.

A concrete-lined canal typically poses a hazard to humans.

Even though swimming is prohibited in the AAC, human drownings are a potential canal-associated hazard. Over the past 10 years, an average of 18 people per year have drowned in the unlined AAC. The majority of these victims were illegal aliens attempting to swim across the canal.

Although the number of canal crossings annually by illegal aliens is not known, a large percentage of them appear to occur at Pilot Knob. Such crossings are purposely done so as to escape notice.

Parallel Canal Alternative

Along the 23-mile section of the proposed parallel canal, the flow velocity would be increased by the reduction in canal cross section. The increase would vary seasonally, depending on canal flow rates and the degree to which water is ponded behind the drop structures. At full flow, the increase would be approximately 35 percent, which could tend to cause more human drownings. However, the preliminary design for a 50-foot bottom width may partially offset the effect of higher velocity on a swimmer crossing the canal. At Pilot Knob, the canal would remain unchanged, possibly causing a greater proportion of the illegal aliens to cross there than at present.

Over time, the sideslope of a concrete-lined canal becomes slippery at the water line and below because of silt and aquatic vegetation. That, combined with a lack of handholds above the water line, tends to make escape from the canal extremely difficult. For a swimmer, this could lead to exhaustion and drowning.

Reclamation standards for canal safety provide for the installation of safety ladders every 750 feet on each side of a canal. The ladders typically are made of welded aluminum and are bolted to the canal sideslope. Additionally, cables with floats are required in front of canal structures.

A newer safety provision is to slipform ridges on the sideslope of the canal during concrete placement. The ridges typically are placed at 18-inch intervals on both sides of the canal, start 9 inches from the top edge of the lining and end below the low canal operating water level, and protrude 1-1/2 inches from the canal sideslope. Tests of such ridges on the Coachella Canal Prototype Lining Project have proven reliable handholds and footholds on a 2-1/2:1 sideslope.

These ridges are proposed for mitigation of the escape hazard to humans in the Parallel Canal Alternative. Based on the field tests on a flatter sideslope, it is assumed that the steps would also be effective on the 1-1/2:1 sideslope proposed for the parallel canal. Nonetheless, field testing would be conducted prior to construction to confirm the effectiveness of the ridges. If field testing indicates that the ridges are not completely effective, safety ladders would be added to the canal design in addition to the ridges. The ridges are desirable for wildlife as discussed under "Large Mammal Escape."

The improvement of the maintenance road along the AAC would tend to promote travel at higher speeds by off-road vehicles, which in turn could increase the accident rate along the canal. This aspect of public safety would be considered during project design in consultation with IID and BLM.

Drop 3 Alternative

This alternative would affect escape from the canal. The concrete sideslope would become slippery at the water line and below due to accumulation of silt and aquatic vegetation. That, combined with a lack of handholds above the water line, would make escape from the canal extremely difficult.

Slipformed ridges are proposed for mitigation of the escape hazard as described for the Parallel Canal Alternative.

Drop 4 Alternative

Same as Drop 3 Alternative.

Well Field Alternative

This alternative would not affect water safety conditions in the canal. The improvement of the maintenance road along the canal and its hazards would be mitigated as in the Parallel Canal Alternative.

No Action Alternative

No change would occur.

EMPLOYMENT AND INCOME DURING CONSTRUCTION

Affected Environment

Total estimated wage and salary employment in Imperial County in 1988 was 39,225 persons. That same year, the following four sectors accounted for almost 80 percent of total wage and salary workers. Construction wage and salary workers accounted for 4 percent.

Also in 1988, the civilian labor force in Imperial County was estimated at 43,725 persons, an increase of 3.4 percent from 1980. Residence-based civilian employment in the county in 1988 averaged 35,025 workers.

Imperial County unemployment rate in 1988 averaged 19.9 percent, the lowest rate within the past decade. This rate is significantly lower than the high unemployment levels of 1982 through 1985 when rates exceeded 30 percent.

Employment sectors	Percent
Agricultural	31
Government	22
Retail	15
Services	12
Other	20
Total	100

Unemployment rates are complicated by the fact that large numbers of workers from Mexicali, Mexico, commute daily across the border to their places of employment. When unemployment occurs, these Mexicali residents file unemployment insurance claims in Imperial County, thus overstating the number of unemployed for the Imperial County area. Unemployment for California and the Nation in 1988 was 5.3 percent.

The average per capita personal income in 1987 for Imperial County was $11,345 as compared to $15,484 for the Nation.

Parallel Canal Alternative

The construction schedule is estimated at 3 years with employment required at different levels throughout the 3-year period. Project employment under this alternative is not anticipated to run in shifts and would be steady throughout the year (table III-16).

It is assumed that 75 percent of contractor manpower requirements would be obtained locally. With the high county unemployment rate, it is expected the contractor would have few problems recruiting labor.

Table III-16.—Contractor and project management employment
Parallel Canal Alternative

Year	Contractor[1]	Management[1]	Total
1	120	35	155
2	185	55	240
3	110	30	140
Total work years	415	120	535

[1]Rounded to nearest five persons.

The estimated salaries of both contractor and project management workers are:

Year	Contractor salaries	Project management salaries	Total
1	$4,460,000	$1,107,000	$5,567,000
2	6,876,000	1,740,000	8,616,000
3	4,089,000	949,000	5,038,000
Total	$15,425,000	$3,796,000	$19,221,000

Of the $19,221,000 in total salaries, it is estimated that approximately 84 percent or $16 million would be spent in the local area. The total economic impact to the local area is estimated at $40 million assuming a multiplier of 2.5.

Drop 3 Alternative

The construction schedule is estimated to be 5 years, with construction employment varying throughout a 5-year period. During the placement of concrete, the project is estimated to run continuously with three shifts a day and most likely for 6 months at a time. Under these conditions, numerous seasonal workers would be needed during this very intensive period. Estimated contractor employment, presented in table III-17, would range from a peak of 270 workers during parts of the last 3 years of construction to a low of 60 full-time workers in the first year.

It is anticipated that 75 percent of the construction manpower requirements would be obtained locally. As a large pool of unemployed labor is located within Imperial County, the contractor would probably have little trouble in finding labor. Twenty-five percent of the labor would be nonlocal and could come from reading or hearing about the project.

Total project management employment required is presented in table III-18. As with construction employment, project management employment would correspond to the triple shift schedule.

Project management employment is anticipated to be 85-percent nonlocal detailed from other projects, and 15-percent local.

The estimated salaries, based on an average wage scale of $18 per hour for contractor workers and $15 per hour for project management workers, are:

Year	Contractor salaries	Project management salaries	Total
1	$2,246,000	$250,000	$2,496,000
2	3,370,000	374,000	3,744,000
3	6,739,000	749,000	7,488,000
4	5,616,000	624,000	6,240,000
5	5,616,000	624,000	6,240,000
Total	$23,587,000	$2,621,000	$26,208,000

Of the $26,208,000 in total salaries, approximately 76 percent or $20 million would be spent in the local area. Approximately 77 percent of contractor salaries would stay in the local area as compared to 68 percent for project management workers. The remaining salaries are estimated to return to areas of nonlocal worker origin. The economic impact to the local area is estimated at $50 million assuming a multiplier (direct and indirect effects) of 2.5.

Table III-17.—Contractor employment
Drop 3 Alternative

Year	Full time	Additional labor peak employment	Peak employment period	Peak employment
1	60	—	—	8
2	90	—	—	90
3	90	180	6 months	270
4	90	180	4 months	270
5	90	180	4 months	270
Total full work years	420	[1]210		[1]630

[1] This number is not additive. It represents full person work years.

Table III-18.—Project management employment
Drop 3 Alternative

Year	Full time	Additional labor peak employment	Peak employment period	Peak employment
1	8	—	—	8
2	12	—	—	12
3	12	24	6 months	36
4	12	24	4 months	36
5	12	24	4 months	36
Total full work years	56	[1]40		[1]96

[1] This number is not additive. It represents full person work years.

Drop 4 Alternative

The construction schedule is estimated to be 5 years with employment varying throughout the 5-year period. During concrete placement, the estimated number of workers would triple due to three shifts or around the clock operation (table III-19).

Table III-20 presents an estimate of total project management employment that would be required. As with construction employment, project management employment would correspond to the triple shift schedule.

Project management employment is expected to be 85-percent nonlocal and 15-percent local.

The estimated salaries of both contractor and project management workers are:

Year	Contractor salaries	Project management salaries	Total
1	$2,995,000	$250,000	$3,245,000
2	6,739,000	749,000	7,488,000
3	5,616,000	624,000	6,240,000
4	4,493,000	499,000	4,992,000
5	6,739,000	749,000	7,488,000
Total	$26,582,000	$2,871,000	$29,453,000

An estimate of approximately 76 percent or $22.6 million would be spent in the local area. Economic impact to the local area is estimated at $56 million, assuming a multiplier of 2.5.

Well Field Alternative

The construction schedule is estimated to be 1-1/2 years. Four separate construction activities—roads; wells; pumps, motors, and piping; and transmission lines and substations—are assumed to be in progress at the same time. The longest construction activity of installing pumps, motors, and piping is estimated to take three-fourths of a year. Project employment is not anticipated to run in shifts and would be steady throughout the construction period. An estimate of the peak contractor and project management employment is:

Contractor	42
Management	10
Total	52

It is assumed that 75 percent of the contractor manpower requirements would be obtained locally. Local high unemployment rates will result in few problems in recruiting labor. It is assumed that 85 percent of the project management workers would be nonlocal.

The estimated salaries of both contractor and project management workers are:

Contractor	$558,000
Management	131,000
Total	$689,000

Of the $689,000 in total salaries, it is estimated that approximately 76 percent or $524,000 would be spent in the local area. The total economic impact to the local area is estimated at $1.3 million assuming a multiplier of 2.5.

No Action Alternative

This alternative would not affect employment and income.

Table III-19.—Contractor employment
Drop 4 Alternative

Year	Full time	Additional labor peak employment	Peak employment period	Peak employment
1	80	—	—	80
2	90	180	6 months	270
3	90	180	4 months	270
4	90	180	2 months	270
5	90	180	6 months	270
Total full work years	440	[1]270		[1]710

[1]This number is not additive. It represents full person work years.

Table III-20.—Project management employment
Drop 4 Alternative

Year	Full time	Additional labor peak employment	Peak employment period	Peak employment
1	8	—	—	8
2	12	24	6 months	36
3	12	24	4 months	36
4	12	24	2 months	36
5	12	24	6 months	36
Total full work years	56	[1]36		[1]92

[1] This number is not additive. It represents full person work years.

LOCAL COMMUNITY STRUCTURE

The seven incorporated cities in Imperial County are Brawley, Calexico, Calipatria, El Centro, Holtville, Imperial, and Westmorland. All of these cities lie within the central agricultural area and comprise about 74 percent of the population in Imperial County.

The largest city and Imperial County seat is El Centro. Yuma, Arizona, is located east of the project area. Both of these cities have economies based on agriculture, tourism, and military. There are also 12 unincorporated communities within the county that are essentially two types—agriculture-related or recreation/retirement-related. A year-round growing season makes the Imperial Valley one of the most productive agricultural counties in the United States and one of the most prominent areas in the United States for penfed cattle.

As of January 1, 1989, the population in Imperial County was estimated at 115,700, an increase of 4 percent over the previous year. Between 1980–89, the county population increased 25.6 percent, which exceeded the State of California growth rate of 21.1 percent.

El Centro has a population of 31,650, and Yuma, about 49,000. The cities of Imperial, El Centro, and Calexico have each grown by one-third since 1980.

Minorities comprise a significant proportion of the population in Imperial County. In 1980, the composition was 56 percent Hispanic, 38 percent Anglo, 3 percent Black, and the remaining 3 percent of various other races.

Agriculture has dominated the economy since early 1900. In 1988, total Imperial County agricultural production and valuation was $976.5 million. That same year, head of cattle numbered over 455,000, and sheep numbered 104,000.

Over one in every three workers is directly employed by an agricultural firm, and even more employees are engaged in agricultural-related activities. Of those directly employed by an agricultural firm, 50 percent are engaged in agricultural services, while over 40 percent are involved in crop production activities. Fewer than 5 percent work with livestock. Portions of manufacturing, wholesale trade, and services have significant ties to agriculture.

Other significant contributors to the local economy are Federal personnel, retail trade, and influx of visitors (referred to as "snowbirds") in the winter months.

Imperial County has a number of geothermal energy developments. The county actively encourages development of its geothermal resources and has adopted policies to encourage resource utilization. Using geothermal energy such as in the processing of agricultural products may contribute significantly to the county in the future.

Parallel Canal Alternative

Impacts to infrastructure of various communities would be minor. Major contractor labor requirements would come from the local area where housing and other services are already being provided. Total contractor and project management peak nonlocal employment is estimated at 93 full-time employees, as discussed under "Employment and Income During Construction."

Total population influx for both contractor and project management workers is estimated at 200 and includes 45 spouses and 63 children. This number of additional people to the area is insignificant. Housing requirements estimated for both contractor and project management are estimated at 29 single family homes, 19 apartments, 25 mobile homes, 17 travel trailers, and 5 sleeping rooms. Current availability of rentals, both apartments and homes, would supply the need. Due to the climate of the area, many would possibly bring their own trailers and park at the jobsite in areas approved by BLM or at existing trailer or RV parks within close commuting distance to the project site.

Drop 3 Alternative

Impacts to local communities would be minor. Major contractor labor requirements would come from the local area where housing and other services are already being provided. Contractor nonlocal employment is estimated at 22 full-time employees and another 45 persons during the high short-term, labor-intensive periods. Project management full-time nonlocal workers are estimated at 10 with another 20 workers during the peak labor-intensive period. Total peak population influx during the peak season is estimated at 153 persons including workers for both project management and contractor workers. This amount is insignificant to the area.

Peak housing requirements are estimated at 19 single family homes, 12 apartments, 14 mobile homes, 30 travel trailers, and 26 sleeping rooms. This amount of housing would be of short duration during this labor-intensive period. Experience with other projects indicates many would bring their own travel trailers and park at either the jobsite or at existing trailer or RV parks within close commuting distance to the project site. As housing requirements are considered to be low for these workers, there would be no significant impact.

Drop 4 Alternative

The only difference between Drops 3 and 4 alternatives would be an extra peak employment period of seasonal workers in year 2 of the Drop 4 Alternative. The peak employment housing needs and population influx would be the same as for the Drop 3 Alternative.

Well Field Alternative

Communities closest to the well field are Yuma and El Centro. Employees would come from both communities in addition to a few from other smaller communities. Due to the small labor requirements and short construction schedule, the nonlocal workforce would have minor impacts to the infrastructure of any community. Total population influx from nonlocal contractor and Government workers would be minimal, as few households would relocate for such a short construction schedule. Housing requirements would be insignificant. Due to the short construction schedule, it is assumed many nonlocal workers would bring campers and trailers and use existing RV parks within close commuting distance to the construction site.

No Action Alternative

This alternative would have no influence on local communities.

IMMIGRATION FROM MEXICO

Affected Environment

Many illegal aliens cross the section of international boundary with Mexico along the proposed project. Most cross in the Pilot Knob area, which is where the canal is closest to development in Mexico. Canal crossings at the drop structures, provided by vehicular bridges, have gates that are locked to all but IID operating personnel and Border Patrol. The canal itself is not fenced, and many illegal aliens swim across the canal. Most of the crossings occur at night. Those attempting to swim the canal are at risk of drowning.

The Border Patrol, whose mission is to prevent illegal entry, patrols this section of the international boundary with the aid of four-wheel drive vehicles to detect and apprehend illegal aliens. Most of the area between the canal and the international boundary is open land that can easily be observed visually.

Parallel Canal Alternative

Between Pilot Knob and Drop 1, construction activity could affect the Border Patrol surveillance at the points where the new canal is connected to the old canal. The clutter of construction equipment and activity may make it easier for illegal aliens to escape detection. The Border Patrol may need to patrol these points more intensely during construction than at present.

Between Drops 1 and 3, construction activity would make it more difficult for the Border Patrol to conduct surveillance and detect the presence of illegal aliens. The Border Patrol would need to patrol the active construction sites more intensely than at present.

After completion, the new canal would not change the fencing at the drop structures and freeway crossings or the Border Patrol access for patrol work. However, the old canal would provide cover for illegal aliens trying to escape detection and might require more intense patrol activity.

Escape ridges already described under "Large Mammal Escape" should reduce risk of drowning. In addition, warning signs in English, Spanish, and international symbols would be posted on both sides of the canal to warn people of the dangerous waters.

Drop 3 Alternative

Construction activity would make it more difficult for the Border Patrol to conduct surveillance and detect the presence of illegal aliens. The Border Patrol would need to patrol the active construction sites more intensely than at present.

After completion, the lined canal would not change the fencing at the drop structures and freeway crossings or the Border Patrol access for patrol work.

Drop 4 Alternative

Same as Drop 3 Alternative.

Well Field Alternative

This alternative would not have an effect on immigration from Mexico.

No Action Alternative

This alternative would not have an effect on immigration from Mexico.

GROWTH INDUCEMENT

Two areas are relevant in the setting of the proposed project—southern Imperial County, in which the project is located, and the southern California coastal area, which is a potential user of the conserved water.

Affected Environment

The population of Imperial County is described under "Local Community Structure," while the population of southern California is presented in chapter I under "Water Need."

Parallel Canal Alternative

Imperial Valley

This alternative would not induce growth in the project area. Water conserved by the project, should it be used there, would provide for higher than normal agricultural needs caused by weather or cropping patterns.

Southern California Coastal Area

This alternative would not have any growth-inducing effect. The growth in this area depends upon national and global economic factors, and regional population and job growth trends. It is controlled under the growth management and land use policies of local communities and regional planning agencies, whose aim is generally to insure that population growth is in balance with jobs, housing, and community structure. Moreover, the water provided by the project, should it be used in the coastal area, would help offset projected water shortages. These project water shortages are based on existing growth projections and are well known to local and regional planning agencies.

Drop 3 Alternative

Same as Parallel Canal Alternative.

Drop 4 Alternative

Same as Parallel Canal Alternative.

Well Field Alternative

Same as Parallel Canal Alternative.

No Action Alternative

This alternative would not have an effect on growth in the project area.

INDIAN TRUST ASSETS

Affected Environment

The first 0.4 mile of canal being considered for lining lies on the Fort Yuma Indian Reservation along a 1,000-foot-wide right-of-way. This right-of-way was obtained for initial canal construction.

The Fort Yuma Indian Reservation contains gravel deposits which may be useable for project construction.

Parallel Canal Alternative

The Parallel Canal Alternative would begin more than a mile from the reservation boundary and thus would not directly impinge on reservation land. However, if contractor access to the upstream end of the project would require crossing reservation land, an agreement with the Tribe would be required. Appropriate compensation and mitigation will be negotiated at that time. In meetings with Reclamation, the Tribe has expressed willingness to reach such an agreement. The area concerned is a highly disturbed borrow pit, and no impacts are expected.

Construction of this alternative would provide an opportunity for the Tribe to market gravel for construction. The suitability of gravel from the reservation for concrete manufacture would need to be determined through laboratory testing during the design phase of the project.

Drop 3 Alternative

The Drop 3 Alternative would begin on the Fort Yuma Indian Reservation within the existing right-of-way for the canal. Contractor access to the upstream end of the project would require crossing reservation land, which would require an arrangement with the Tribe.

Construction of this alternative would provide opportunities for the Tribe to market gravel, as discussed under "Parallel Canal Alternative."

Drop 4 Alternative

Construction of this alternative would have the same effects on Indian trust assets as the Drop 3 Alternative.

Well Field Alternative

The wells to be constructed under this alternative would begin about 1 mile west of the reservation boundary. However, contractor access to begin the project might require crossing reservation land, which would require an arrangement with the Tribe.

No Action Alternative

This alternative would not affect Indian trust assets.

CHAPTER IV

Cumulative Impacts