CHAPTER II

Alternatives

Chapter II

ALTERNATIVES

This chapter presents the canal lining alternatives developed and evaluated for consideration. Other alternatives considered but eliminated are presented at the end of this chapter. The alternatives were developed in a manner consistent with the National Environmental Policy Act and California Environmental Quality Act, which call for the examination of a range of alternatives.

SCOPE OF ALTERNATIVES

The need to keep the canal in service year round limits the range of physical options to: (1) line the existing canal under water, (2) construct a new concrete-lined canal parallel to the existing canal, or (3) recover the seepage from wells along the canal. A pipeline or other closed conduit was not considered because of prohibitive cost.

The greatest seepage reduction would be attained by lining the entire 29.9-mile section of canal under consideration. This distance spans four reaches, separated by drop structures with hydroelectric power generating plants. The major difference among the four reaches is that a tract of seepage-induced wetlands lies along the canal between Drops 3 and 4. Lining between Drops 3 and 4 would require an expensive program to mitigate the impacts to the seepage wetlands. Thus, separate alternatives were studied for lining from Pilot Knob to Drop 3 and Pilot Knob to Drop 4. Wells were considered between Pilot Knob and Drop 2. Wells further downstream would increase seepage downstream from Drop 2.

The planning process produced the following four action alternatives (figures II-1 and II-2). These alternatives are presented and analyzed in this document together with the requisite No Action Alternative.

Alternative	Description
Parallel Canal Alternative	**Preferred Alternative** - New parallel canal from 1 mile west of Pilot Knob to Drop 3 (23 miles)
Drop 3 Alternative	In-place lining from Pilot Knob to Drop 3 (24.6 miles)
Drop 4 Alternative	In-place lining from Pilot Knob to Drop 4 (29.9 miles)
Well Field Alternative	Wells along the canal between Pilot Knob and Drop 2 (15 miles)
No Action	Canal remains unlined (29.9 miles)

The Well Field Alternative would have a lower cost, a shorter construction period, and less environmental impact than the other alternatives. However, the Well Field Alternative was not selected as the preferred alternative because it would have a potential for international complications.

Mexico, as a matter of principle, would likely object to this alternative because the wells would penetrate a ground-water reservoir supplying wells used for irrigation in the Mexicali Valley in Mexico.

Table II-1 summarizes physical properties and design elements and costs for each alternative.

PARALLEL CANAL ALTERNATIVE (PREFERRED ALTERNATIVE)

The preferred alternative is to construct a parallel canal from 1 mile west of Pilot Knob to Drop 3, a distance of 23 miles. The beginning would be west of Pilot Knob to avoid impact to the culturally sensitive Pilot Knob Area of Critical Environmental Concern. The starting point is 1.6 miles downstream from Rock Section 2 (or about 1 mile west of Pilot Knob). Centerline of the new canal would be offset from the old centerline of the original canal by a distance of 300 to 600 feet, depending on terrain, ease of construction, and location of existing structures. At the Sand Hills, the new canal would be as close to the existing canal as possible to minimize the amount of excavation through the sand dunes. This alternative would conserve approximately 67,700 acre-feet of water per year.

Canal Design

Design studies to date have produced a canal design with a 50-foot bottom width and sideslopes of 1-1/2 horizontal to 1 vertical (1-1/2:1). Figure II-3 shows the cross section.

Concrete escape ridges would be cast on the sideslopes from the top to about halfway down to the canal bottom to provide grip for humans and wildlife. The ridges would protrude about 1-1/2 inches from the canal lining and be spaced about 18 inches apart.

The current design is based on the same flows as used for the existing canal, as shown below.

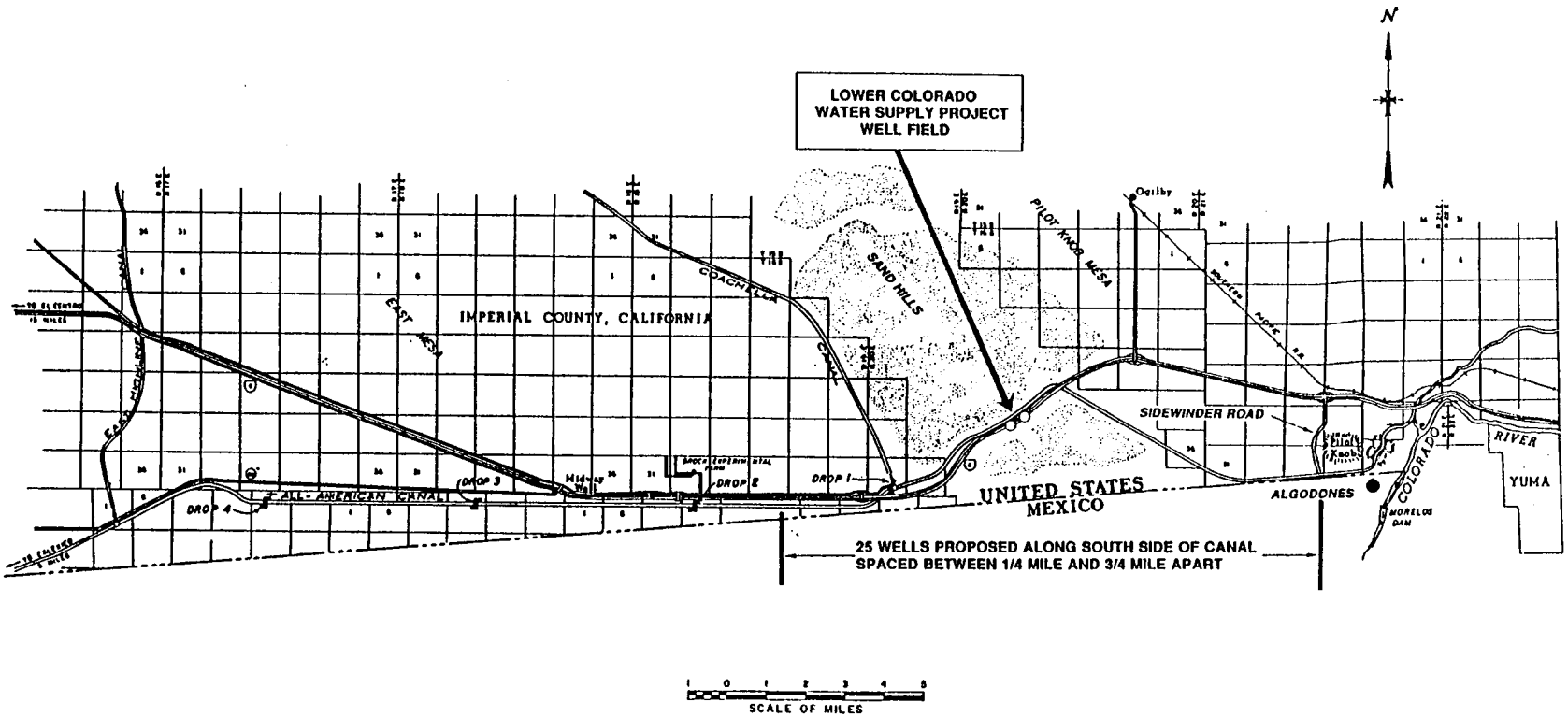
Canal characteristics by reach

Reach	Capacity in cubic feet per second	Miles	Design water depth
1	10,155	13	23.25
2	7,600	5	19.96
3	7,400	5	19.36

Final design studies may produce slightly different canal cross sections.

The parallel canal would be connected to the existing canal immediately upstream and downstream from the existing drop structures and interstate highway bridges which would still be used. This would involve a total of 10 tie-ins to the existing canal, but would avoid costs of rebuilding Drops 1 and 2 and four two-lane bridges. The problems and expenses of highway relocations and detours, transmission line extensions, and possible electrical outages at powerplants would also be avoided.

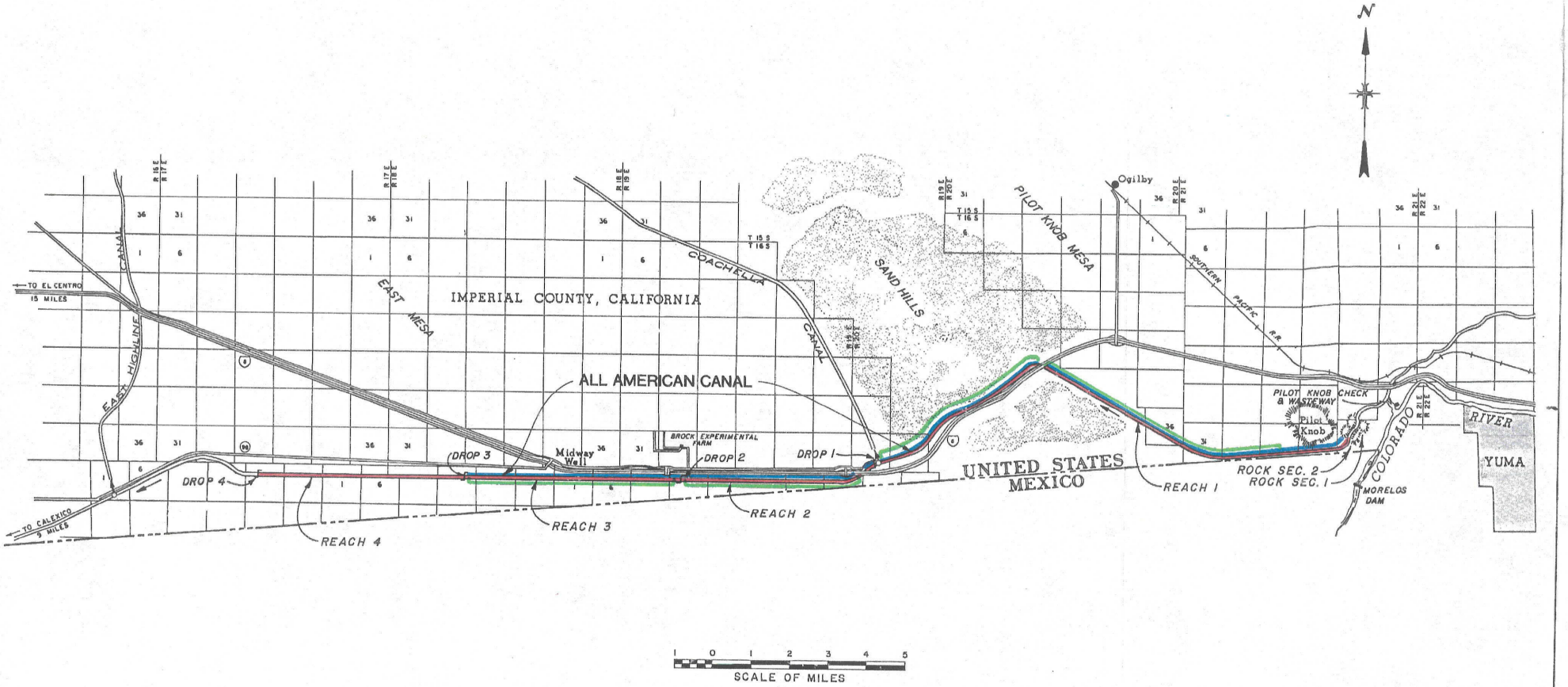
The tie-ins would be paved with concrete; the exact methods and procedures would be developed during the design phase. Gates or other structures would be incorporated into the new canal at the tie-ins to connect each section of new canal to the old canal. These connections would permit use of the old canal in case of emergency.



WELL FIELD ALTERNATIVE

ALL-AMERICAN CANAL LINING PROJECT
IMPERIAL COUNTY, CALIFORNIA

Figure II-2



EXPLANATION

- PARALLEL LINING TO DROP 3
- IN-PLACE LINING TO DROP 3
- IN-PLACE LINING TO DROP 4

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALL-AMERICAN CANAL LINING PROJECT
IMPERIAL COUNTY, CALIFORNIA

LOCATION MAP

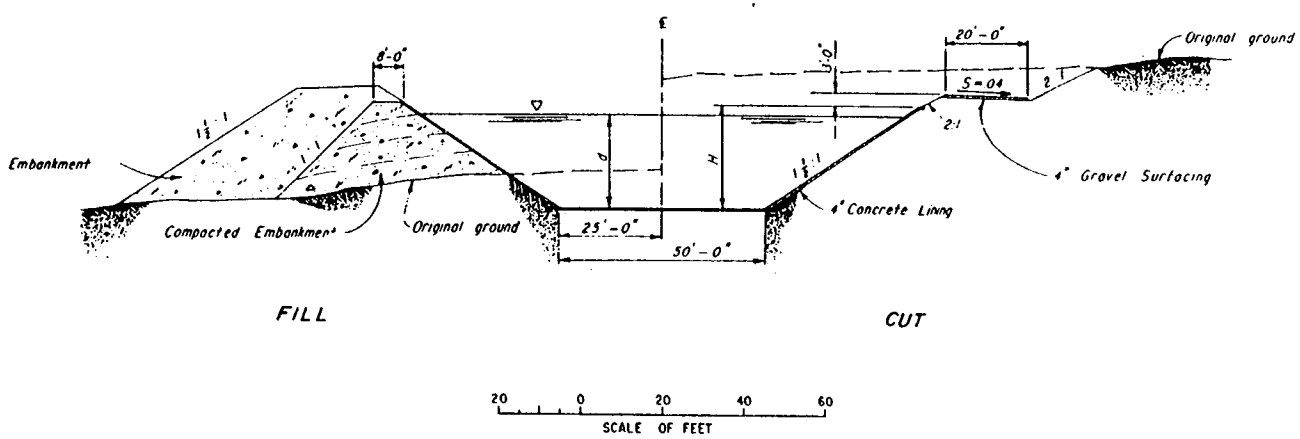
DENVER, COLORADO APRIL 1991

MAP NO. 212-300-459

Table II-1.—Summary of physical properties and design elements and costs

Dimension	Existing canal	Parallel Canal Alternative	Drop 3 Alternative	Drop 4 Alternative	Well Field Alternative
Length involved (miles)	[1]29.9	23.0	24.6	29.9	15.0
Excavation volume (million cubic yards)	—	25.0	0.8	1.0	—
Concrete volume (cubic yards)	—	214,000	265,000	320,000	800
Sand and gravel volume (cubic yards)	—	185,000	355,000	535,000	41,000
Top width[2] (feet)	196	120	215	215	196
Water depth[2] (feet)	16.6	23.1	[3]15.5	[3]15.5	16.6
Sideslopes[4]	2:1	1-1/2:1	2-1/2:1	2-1/2:1	2:1
Water volume[5] (acre-feet)	8,630	6,800	8,900	9,300	8,620
Water velocity at full flow[6] (feet per second)	3.8	5.2	4.1	4.1	3.8
Water conserved annually (acre-feet)	—	67,700	66,700	68,700	68,000
Construction cost[7] (1990 $ millions)	—	86.4	105.7	137.9	21.0
Cost per acre-foot of water conserved (1990 dollars)[8]	—	109	135	171	69
Operation and maintenance annual cost increase (1990 dollars)	—	14,000	14,000	26,000	[9]2,930,000

[1] From Rock Section 2 at Pilot Knob to Drop 4.
[2] Between Pilot Knob and Drop 1 at full canal flow. Downstream from Drop 1, the dimensions are approximately 88 percent of values shown.
[3] Checked to depth of 16.6 feet at upstream end of Drop 1.
[4] Horizontal distance to vertical distance.
[5] Entire 29.9 miles. Does not include effect of silt deposition in canal.
[6] Average velocity in canal at maximum waterflow (10,155 cubic feet per second). Velocity at sides of canal is less than average. Velocity at center of canal is greater than average.
[7] Includes cost of mitigation.
[8] For comparison purposes; based on cost recovery at 8-percent interest over an assumed 50-year period.
[9] Annual equivalent; based on future price escalation of 5 percent per year.



HYDRAULIC PROPERTIES										
REACH	STATION TO STATION			A	V	Q	r	n	s	d	H
1	1186 + 80	to	1623 + 30	1953.75	5.20	10,155	14.66	.015	.0000767	23.09	25.9
1	1639 + 80	to	1896 + 50	1973.70	5.15	10,155	14.75	.015	.0000746	23.25	26.1
2	1940 + 20	to	2181 + 20	1595.60	4.76	7,600	13.08	.015	.000075	19.96	22.6
3	2192 + 80	to	2463 + 40	1530.32	4.84	7,400	12.77	.015	.0000798	19.36	22.0
4	2485 + 30	to	2747 + 80	1482.52	4.79	7,100	12.54	.015	.0000802	18.92	21.5

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION DENVER, COLORADO	ALL-AMERICAN CANAL LINING PROJECT Imperial County, California	TYPICAL PARALLEL CANAL SECTION Figure II-3

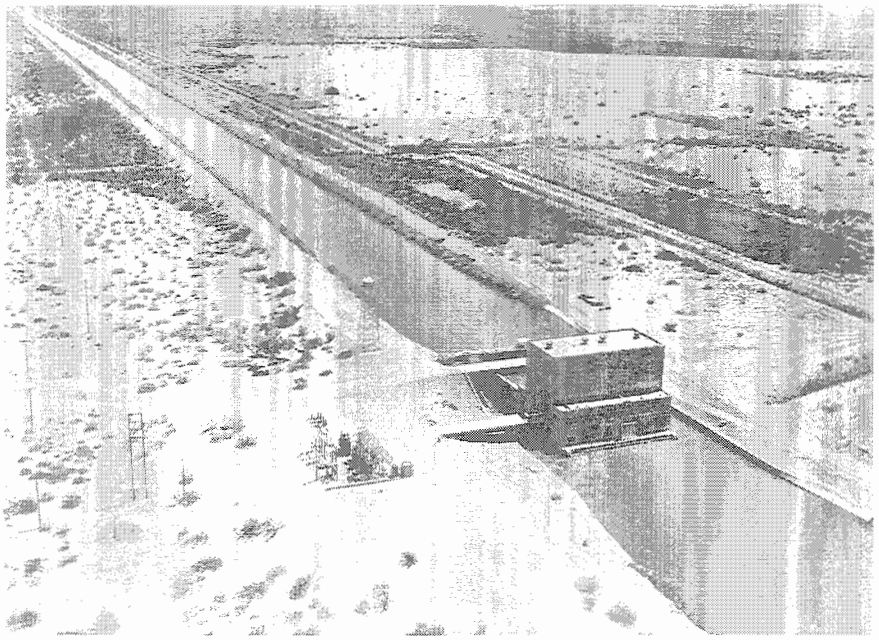


Photo 2.—View looking southeast shows the All-American Canal Drop 3 with hydroelectric powerplant. The proposed parallel canal (preferred alternative) would lie to the right of the canal.

Operation and maintenance (O&M) roads would be 20 feet wide to match the existing canal roads. The road on one side would be gravel surfaced.

Construction Activities

The new canal would require excavation of 25 million cubic yards of earth. Excavated material in excess of that needed for canal embankments would be deposited in rows along the new canal. No borrow for earthfill would be required. Water for construction purposes would be available from the All-American Canal (AAC).

The relocated canal would require an estimated 530 acres of new right-of-way, all of which is under Federal control. The 530 acres consist of land outside the existing right-of-way where a new width of 200 feet on each side of the centerline would be required. An exception would be Reach 1B, where a 400-foot width on the right side would be required due to large cuts in the sand dune area.

Other land disturbances associated with construction would include a 10-acre concrete batch plant and three 5-acre staging areas, all within the desert scrub community on previously disturbed lands.

To make the tie-ins, a reach of new canal would be connected to the existing canal at the downstream end and then at the upstream end, establishing a flow in both new and old canals. Next, sheet piling would be driven across the old canal at the upstream end, generally along the alignment of the proposed embankment. This would divert all the flow to the new canal and also would serve as support for the new canal embankment (O&M road) which could then be constructed over and

around the sheet piling. The downstream end of the old canal could then be cut off by placing an embankment across the canal.

Relocations

A 69-kilovolt triple wood pole powerline crosses the canal just upstream of the first Interstate 8 (I-8) bridge crossing. One tower located on the east side of the canal may require relocation, depending on the exact canal alignment selected. Also, just upstream of Drop 1, powerlines cross the canal near where the new canal would tie in with the existing structure, and certain poles for these lines would require relocation.

Geodetic control monuments may be in the project area. If any construction activities could disturb or destroy any such monuments, the project would fund relocation costs as part of total construction costs.

Mitigation Features

A variety of mitigation features are included in this alternative to compensate for impacts on wetlands vegetation, fish in the canal, canal bank vegetation, terrestrial habitat, and cultural resources.

Wetlands mitigation would consist of the establishment of 43 acres of honey mesquite and cottonwood/willow, and 1 acre of marsh in the Drops 3 to 4 wetlands complex. The number of plantings in the riparian vegetation mitigation sites would achieve a density of about 100 mature trees per acre. Specific sites would be selected based upon physical and biological 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 regulatory concern such as the federally endangered Yuma clapper rail and the California black rail.

Fish mitigation would consist primarily of restoring shelter for juvenile fish by means of artificial reefs in the lined canal. Alternatives are fish stocking and developing habitat in regulating reservoirs.

Canal vegetation mitigation would consist of providing replacement habitat for special status species and would contribute to maintaining an important area fishery for recreational fishing. The mitigation would also help support the national goal of no overall net loss of wetlands and would further contribute to the general environmental quality of the project area. The sponsors have agreed to provide this mitigation.

Mitigation for the loss of the terrestrial habitats of the flat-tailed horned lizard and other special status plant and animal species would consist of the replacement and protection of those habitats. Replacement would be on an acre-for-acre basis, based on ecological equivalency.

Preconstruction surveys would be undertaken to identify cultural sites and to evaluate significance of the resources. Where avoidance is not practical, significant sites would be mitigated appropriately. The level of mitigation would be decided in consultation with California State Historic Preservation Office, Quechan Indian Tribe, and Advisory Council on Historic Preservation.

Details of all mitigation features are presented in chapter III with the discussion of affected resources. Table II-2 shows the estimated costs of mitigation commitments for the preferred alternative.

Table II-2.—Estimated costs of mitigation commitments for the preferred alternative

Mitigation commitment	Cost
Lower Colorado River backwater restoration fund	[1]$100,000
Wetlands mitigation	[2]150,000
One-to-one replacement of disturbed flat-tailed horned lizard habitat and sand dune habitat. Purchase of up to approximately 1,503 acres[3] at $500 per acre	[4]751,500
Installation of tire reefs to replace lost shoreline canal fishery habitat	[2]250,000
Large mammal/human escape ridges	[5]—
Archeological surveys	[2]100,000
Stockpiling and recontouring of surface soils	[6]60,000
Develop interim recreation plan	[7]5,000
Total capital costs	$1,416,500
Mitigation annual operation and maintenance	[2]$46,000

[1] From chapter III, "Wetlands Along the Colorado River."
[2] From Engineering Appendix to the draft environmental impact statement/environmental impact report.
[3] Maximum probable impact estimate, from chapter III, "Special Status Species."
[4] Assumed price of $500 per acre for undeveloped land in Imperial Valley. Replacement lands would be acquired in accordance with section 203(a)(2) of Public Law 100-675 (attachment A of the final environmental impact statement/final environmental impact report). In addition, acreage may be reduced based on actual construction impacts.
[5] Cost of incorporating this measure is included in the cost of constructing the canal lining.
[6] U.S. Fish and Wildlife Service estimate for Coachella Canal Lining Project. Assumed to be approximately accurate for the All-American Canal Lining Project.
[7] Bureau of Reclamation estimates. Implementation costs are included in the cost of constructing the canal lining.

Permits and Agreements

Title II of Public Law 100-675 (attachment A) authorizes the Secretary of the Interior (Secretary) to line the canal, construct mitigation facilities, and accept non-Federal funding from participating California water agencies. Prior to initiation of construction, participating agencies must enter into a project agreement with the Secretary. This agreement will specify funding arrangements for construction and operation, responsibilities of the various parties involved, and various other provisions.

A section 402 permit (under the Clean Water Act) would be required from the California Regional Water Quality Control Board.

The U.S. Army Corps of Engineers has considered this project and the coordinated mitigation planning involved and has decided not to exercise its authority for the construction of the project (letter of March 11, 1990). No section 404 permit would be required.[1]

A section 1601 permit for wetlands alteration would be required from the California Department of Fish and Game.

Air quality permits would be required from Imperial County for the concrete batch plant and earthwork activities.

Construction Cost

The Metropolitan Water District of Southern California (MWD) estimated the construction cost at $86.4 million, including mitigation features, based on 1990 prices. The cost per acre-foot of water conserved is estimated at $109 per acre-foot.

This cost is an approximation developed for comparison of alternatives by: (1) adding the construction cost and interest during construction, (2) computing the annual cost at 8 percent over a 50-year period, and (3) dividing the annual cost by the amount of water conserved annually. Interest during construction was computed on expenditures for a reach between the time the expenditures are made and the time water is available from that reach, assumed to be within a year. The actual cost of conserved water would depend on the interest rate at which non-Federal funds were available at the time of construction, as well as the actual construction costs.

Construction Schedule

The project schedule would be 5-1/2 years. The projected schedule includes a 2-1/2-year preconstruction period for items such as establishing a field organization, hiring personnel, environmental and cultural resources surveys, and collecting design data through drilling and surveying. Design work would begin in the second year. Construction would begin in the third year and would be completed in the final 3 years.

Project Operation

Canal Operation

As in the past, the canal would be in service year round and operated at as high a water level as possible at all times to maximize power generation at the drop structures. The Imperial Irrigation District (IID) would operate and maintain the parallel canal after lining. The old canal would be retained for emergency use under an O&M plan to be developed during project design.

Use of Conserved Water

Public Law 100-675 provides that four California agencies, Palo Verde Irrigation District, IID, Coachella Valley Water

[1] A section 404 permit covers the alteration of wetlands. The U.S. Army Corps of Engineers reserves the right on a case-by-case basis to determine whether a particular water body requires a section 404 permit.

District, and/or MWD, may fund project construction. The law states that the conserved water will be made available for consumptive use by the four agencies according to their priorities under the Seven Party Agreement. However, the law provides that if a nonfunding agency were to use some of the conserved water, that agency would be required to reimburse the funding agency(ies) for the proportionate cost of the water used.

The general premise under which this project is being developed is that MWD would fund this project with the expectation of using the conserved water, except when the water may be used by another agency. In that case, MWD would be reimbursed monetarily for such use. A commitment to fund project construction would be established only with the execution of the project agreement cited above and filing of a record of decision after certification of this final environmental impact statement/environmental impact report.

Operation and Maintenance Cost

O&M costs for the parallel canal would decrease, but the addition of O&M costs for mitigation features would cause a net increase in cost. The operation costs would not change, since costs reflect hydrographer salaries, office materials, transportation, and other office-oriented equipment. However, maintenance costs associated with canal maintenance, weed and brush removal, and drain maintenance would decline. The project mitigation features would require maintenance. In addition, ground-water levels and soil salinity in the wetland complex between Drops 3 and 4 would need to be monitored. Annual cost estimates are as follows:

	Present	Parallel canal
Canal O&M	$265,000	$233,000
Fish and wildlife, wetlands mitigation O&M, and monitoring	0	46,000
Total	$265,000	$279,000
Net difference		$14,000

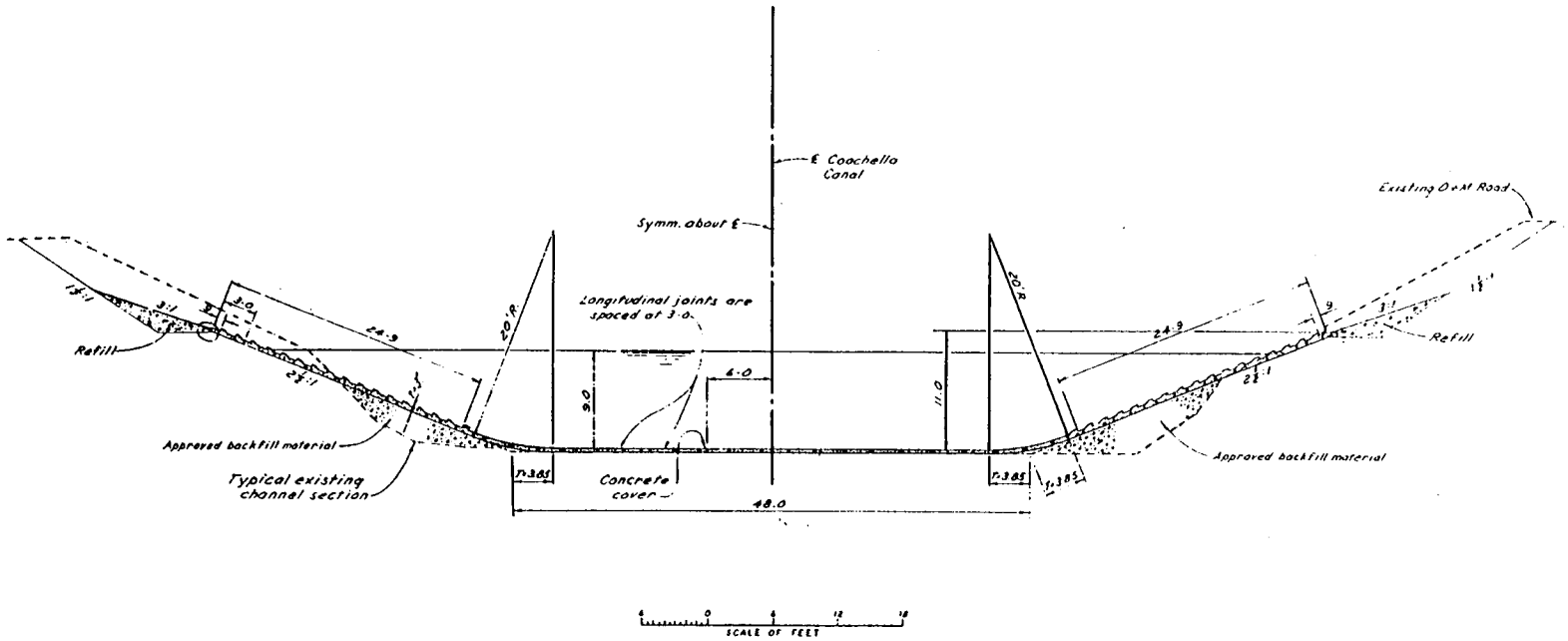
Historically, there has been sediment buildup in the existing canal; however, to date, this buildup has not hindered the operation. As IID has not cleaned the existing canal as part of its maintenance program for the past 50 years, IID would probably not have to clean the parallel canal even though a sediment buildup could occur after lining. Therefore, cleaning costs were not included in this O&M estimate.

DROP 3 ALTERNATIVE

This alternative would be in-place lining of the canal from Pilot Knob to Drop 3, a distance of 24.6 miles. The canal would be lined while still in service, allowing uninterrupted delivery of irrigation water. This alternative would conserve approximately 66,700 acre-feet of water per year.

Lining Design

The preliminary design is based on placing a 30-mil-thick polyvinylchloride (PVC) impervious plastic liner in the canal covered by a 3-inch layer of concrete. When lined, the canal bottom width would be 134 feet (4 feet wider than originally constructed) and have 2-1/2:1 sideslopes. Figure II-4 shows a cross section used in the Coachella Canal Prototype Lining Project (the AAC lining would be wider and deeper).



UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION DENVER, COLORADO	ALL AMERICAN CANAL LINING PROJECT Imperial County, California	PROTOTYPE LINING TYPICAL CANAL SECTION Figure II-4

Concrete escape ridges would be cast on the sideslopes from the top halfway down to the canal bottom to provide grip for humans and wildlife. The ridges would protrude at least 1-1/2 inches from the canal lining and be spaced about 18 inches apart.

Construction Activities

The new lining method would use specialized equipment that would trim the sides and bottom of the earthen canal to a uniform shape and place the PVC membrane and concrete cover.

The equipment would be supported on a structural truss spanning part or all of the canal. During a single integrated paving operation, the PVC sheet would be placed in one-quarter of the canal, and 3-inch concrete placed over the plastic and geotextile sheet. The PVC on the sideslope would be covered with a geotextile sheet to help the concrete adhere to the sideslope.

Sand and silt excavated from the canal bottom would be discharged as a slurry onto desert terrain adjacent to each canal bank, where the water would seep into the sandy soil. The slurry would be confined where needed to prevent undesirable spread. In the vicinity of Pilot Knob, the cuttings would all be confined in depressions on the south side of the canal.

Generally, construction would begin between Pilot Knob and Drop 1 at a location to be selected based on ease of access and equipment assembly. Initial construction would involve a startup phase to develop and test new equipment.

The feasibility of the in-place lining method has been tested on a 1.5-mile prototype section between Siphons 14 and 15 of the Coachella Canal. Additional equipment development and testing would be needed to prepare for lining the wider AAC.

Observation concluded that land would be disturbed mainly on the berms on both sides of the canal. The berms are graded to facilitate the movement of heavy equipment. Spoils from the canal trimming were placed outside the berms in previously disturbed areas. On the AAC, the width of this band of encroachment would be 50 feet.

Additional land disturbances associated with construction would include a 10-acre concrete batch plant and three 5-acre staging areas, all within desert scrub community on previously disturbed lands.

Mitigation Features

The mitigation features of this alternative should be similar to those for the Parallel Canal Alternative, except that less land would be disturbed and fully mitigated than under the Parallel Canal Alternative.

Permits

The same permits would be required as for the Parallel Canal Alternative.

Construction Cost

The Bureau of Reclamation (Reclamation) has estimated the construction cost at $105.7 million, which includes the cost of mitigation features, based on 1990 prices.

The cost per acre-foot of water conserved is estimated at $135 per acre-foot, calculated as described for the Parallel Canal Alternative.

Construction Schedule

The project schedule would be 6-1/2 years. The projected schedule includes a 1-1/2-year preconstruction period for items such as establishing a field organization, hiring personnel, completing environmental and cultural resources surveys, collecting design data, and preparing construction specifications. Construction would begin in the third year and would be completed in the final 5 years. This schedule would include the manufacture of equipment.

Project Operation

Project operation provisions are the same as for the Parallel Canal Alternative. IID would operate and maintain the canal.

Operation and Maintenance Cost

O&M costs would change as described under the Parallel Canal Alternative.

DROP 4 ALTERNATIVE

This alternative would be in-place lining of the canal from Pilot Knob to Drop 4, a distance of 29.9 miles. This alternative would be the same structurally as the Drop 3 Alternative, except that the 5.3 miles between Drops 3 and 4 would be added. This alternative would conserve approximately 68,700 acre-feet of water per year.

Lining Design and Construction

The lining design and method of construction would be the same as for the Drop 3 Alternative.

Mitigation Features

Mitigation features included in this alternative would compensate for impacts on wetlands vegetation, fish in the canal, terrestrial resources, cultural resources, and other environmental aspects. Wetlands mitigation would consist of restructuring the wetland complex between Drops 3 and 4 to maintain the marsh vegetation in place and replace habitat values of lost riparian vegetation.

There are about 1,550 acres of wetlands in the vicinity of the AAC between Pilot Knob and Drop 4. Ninety-two percent (1,420 acres) of these wetlands are located in a single complex between Drops 3 and 4. Seven percent (112 acres) of the total is marsh vegetation, 50 percent is salt cedar, and approximately 20 percent is arrowweed.

A wetlands complex equal in value to all wetlands that would be affected by this alternative would be created on the same site as the existing complex. Delivered water could be gravity fed from the AAC.

Fish mitigation would consist of restoring shelter for juvenile fish by means of placing artificial reefs in the lined canal to replace lost shoreline habitat diversity in the canal system.

Details of all mitigation features are presented in chapter III with the discussion of environmental resources affected.

Permits

The same permits would be required as for the Parallel Canal Alternative.

Construction Cost

Reclamation has estimated the construction cost at $137.9 million, which includes mitigation features, based on 1990 prices.

The cost per acre-foot of water conserved is estimated at $171 per acre-foot, calculated as described for the Parallel Canal Alternative.

Construction Schedule

Project schedule would be 8-1/2 years for the Drop 4 Alternative. The time allowance includes time to design and develop a restructured wetlands complex between Drops 3 and 4. The projected schedule provides for a 3-1/2 year preconstruction period for items such as establishing a field organization, hiring personnel, collecting design data, cultural resources surveys, preparing construction specifications, and completing environmental planning work, primarily for the wetlands mitigation program. The latter accounts for most of the additional 2 years beyond that required for the Drop 3 Alternative. Design work would begin in the second fiscal year. Construction would begin in the fifth year and would be completed in 5 years.

Project Operation

Project operation provisions are the same as for the Parallel Canal Alternative.

Operation and Maintenance Cost

IID would continue to operate and maintain the canal after lining. The change in O&M cost would be similar to that for the Drop 3 Alternative; however, mitigation O&M would be slightly higher. A net increase of $26,000 annually is estimated.

WELL FIELD ALTERNATIVE

The Well Field Alternative would consist of constructing wells along part of the AAC to recover seepage water from beneath the canal. The amount of seepage recovered is equal to the amount of water pumped from the ground-water aquifer, which would be 68,000 acre-feet annually.

Well Field Design

The plan is to construct 25 wells along the canal. Each well would be about 500 feet deep with 300 feet of screen. The design pumping rate would be approximately 7 cubic feet per second. This rate is approximately 90 percent greater than the theoretical capacity required to pump the proposed amount of water to compensate for pump shutdowns, maintenance, and power outages.

The wells would be located in a single line on the south side of the canal starting near Pilot Knob and ending between Drops 1 and 2, a distance of approximately 15 miles (figure II-2). The wells would be variably spaced from one-fourth to three-fourths of a mile apart, depending on terrain, geology, existing structures, and the presence of environmental and cultural resources. The spacing would take into account the wells constructed as part of the Lower Colorado Water Supply Project, which are on the south side of the AAC in the vicinity of the I-8 rest area in the Sand Hills.

The pumped water would be conveyed to the canal by steel pipes running directly from the wells to the canal. The pipes would be buried under the canal bank service road but would discharge above the canal water surface.

Access to each well site would be from the canal maintenance road along the canal. Generally, the well sites would be connected to the maintenance road by a short spur road cut through the spoil bank along the canal. Between Pilot Knob and the Sand Hills, there are existing gaps in the spoil pile approximately every half mile, which would provide access with little excavation. The canal maintenance road, well construction pads, and connecting spur roads would be paved with gravel. The well sites would be fenced.

Electric power for the wells would be supplied by a powerline to be constructed along the south side of the canal containing the wells. The electrical substation at Drop 1 would be expanded to supply power to the new powerline.

Observation wells would be installed along the canal to monitor the ground-water levels.

Construction Activities

Construction of most wells would require the clearing of a site approximately 100 feet square (approximately one-fourth acre) adjacent to the toe of the south canal bank and spoil berm. Any material removed from the existing spoil bank would be spread on the site to form a drill pad, which would be paved with gravel.

Water for drilling would be obtained from the canal. It is estimated that 1 to 10 acre-feet would be needed. Drilling fluids would be contained on the site.

Mitigation Features

Mitigation features would be included to compensate for minor project impacts. Any loss of terrestrial habitat for the flat-tailed horned lizard would be replaced on an acre-for-acre basis by improvement of habitat elsewhere. Any short-term impact on recreation and public safety would be minimized through an interim recreation management plan to be developed jointly with the Bureau of Land Management.

Details of mitigation features are presented in chapter III with the discussion of environmental resources affected.

Permits and Agreements

The permits and agreements needed for this alternative would be essentially the same as for the Parallel Canal Alternative, except that a section 1601 permit for wetlands alteration would not be needed from the State of California.

Construction Cost

Reclamation has estimated the construction cost at $21 million, which includes the cost of mitigation features.

The cost per acre-foot of water conserved is estimated at $69 per acre-foot. This cost is an approximation developed for comparison of alternatives by computing the annual cost of construction at 8 percent over a 50-year period, adding the annual operation, maintenance, and replacement (OM&R) cost, and dividing the sum by the amount of water conserved annually. The actual cost of conserved water would depend on the interest rate at which funds are available at the time of construction, as well as actual construction and operation costs.

Construction Schedule

The construction period would be approximately 1-1/2 years following the design period, which would be 6 months or more, depending on the complexity of studies needed to determine well locations.

Project Operation

IID would operate and maintain the well field.

The water conserved by this alternative would be used as described under the Parallel Canal Alternative.

Operation, Maintenance, and Replacement Cost

The OM&R costs for the well field are estimated to cost $2.93 million per year. This consists of O&M of the well field by IID employees, electric energy at a rate of 55.5 mills per kilowatthour, and replacement of wells, pumps, motors, and accessory equipment every 17 years, the estimated average operating life.

The OM&R cost above is an annual equivalent amount based on future escalation of power rates and other costs at 5 percent per year.

NO ACTION ALTERNATIVE

No action would be taken. The canal would remain unlined, and the seepage would continue. IID would continue to operate and maintain the canal. This alternative forms the baseline from which project effects are measured.

ALTERNATIVES CONSIDERED BUT ELIMINATED

Parallel Canal to Drop 4

This alternative would have been similar in design to the Parallel Canal Alternative presented in this report, except that it would be about 5 miles longer. The parallel canal would be located on the south side of the existing canal between Drops 3 and 4.

This alternative was dropped for several reasons. At the time the alternatives were formulated, this alternative was regarded as being more expensive than in-place lining. Also, the parallel canal would pass through the center of the wetlands complex on the south side of the canal between Drops 3 and 4. Placing the parallel canal on the north side of the existing canal would also have affected wetlands habitat. Generally, it was felt that consideration of lining the canal between Drops 3 and 4 should be limited to the Drop 4 Alternative with in-place lining.

Combination of In-Place Lining and Parallel Canal Construction

The canal could be lined by a combination of in-place lining and parallel canal construction. A typical alternative would be to line the canal in-place upstream from Drop 1 where it runs through the sand dunes and to construct a parallel canal along the reaches between Drops 1 and 3.

Compared to the Parallel Canal Alternative, this would eliminate the greatest amount of excavation and would allow the lining to start at Rock Section 2, rather than 1.6 miles downstream, west of Pilot

Knob. Under this alternative, construction of the parallel canal downstream from Drop 1 would begin first, and the in-place lining of the canal upstream would start about a year later because of its longer startup time.

This alternative was not pursued because it would not be as economical as using a single method. The cost of lining equipment needed for each method would be spread over a shorter part of the canal. This alternative also would be affected by the uncertainties and developmental work needed to perfect the in-place lining process for such a long canal. However, should an economical process be developed, these portions may be lined in this manner. The need for additional environmental compliance would be evaluated at that time.