
SECTION 11 SELECTION OF THE ENVIRONMENTALLY PREFERRED PROJECT ALTERNATIVE

11.1 METHODOLOGY FOR COMPARISON OF ALTERNATIVES

11.1.1 GENERAL

Studies of the four alternatives (other than the No Project Alternative) and their appurtenant facilities were performed to evaluate each alternative's potential impact to the environment. These studies developed information which was then used to evaluate the alternatives.

Based on this information, the relative impacts and benefits of the four alternatives were evaluated using 27 separate parameters that permit quantitative evaluation of the practicability and environmental/social impacts of each alternative as shown in Table 11-1. The evaluation parameters were selected because they met the following tests:

a. Importance

Each parameter represents an important characteristic of the four alternatives. A characteristic could affect either project practicability or the nature and extent of environmental impacts associated with construction and operation of the alternatives.

b. Quantitative Measurement

All 27 parameters are measurable using field data, allowing alternatives to be compared objectively. Decision-makers and the public therefore have a concrete basis for evaluation and selection of the project alternatives.

c. Redundancy

Each of the 27 parameters was selected because it measures a discrete characteristic of the Cadiz Project. The parameters avoid the potential for double counting and the inadvertent bias that this may introduce into decision-making processes.

11.1.2 CRITERIA FOR EVALUATION OF ALTERNATIVES

Practicability Measures

Based on engineering, geotechnical and hydrologic analyses, ten parameters were selected as the basis for comparing the practicality of the alternatives.

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**TABLE 11-1
EVALUATION CRITERIA FOR THE
PROJECT ALTERNATIVES**

Criteria	Units of Measurement	Criteria Weight
Practicability Measures (50% of Total Weight)		
Project cost	Dollars	0.091
On-line date	Months beyond target date	0.082
Risk to existing infrastructure	Miles adjacent to existing infrastructure	0.073
Proximity to salt playas	Miles within delineated dry lakes	0.064
Construction within sand dunes	Miles within sand dunes	0.055
Construction/maintenance access	Miles from road or railroad	0.045
Internal pipeline pressure	Feed (elevation) of head	0.036
Arroyo wash crossings	Number of crossings	0.027
Construction in rock	Miles with delineated rock structures	0.018
Right-of-way acquisition	Miles within private ownership	0.009
Environmental/Social Impacts Measures (50% of Total Weight)		
Desert tortoise	Number of signs per alternative	0.053
Wildlife corridors crossed	Miles of designated corridors blocked	0.048
Wilderness area compatibility	Miles of alternative adjacent to wilderness area	0.048
Air quality	Tons of No _x and PM ₁₀ emissions during construction	0.044
Mojave fringe-toed lizard habitat	Miles of suitable habitat crossed	0.041
Cultural/ethnographic resources, including historic and pre-historic resources, ethnographic concerns and paleontological resources	Number of sites/issues affected	0.038
Mojave wash scrub habitat	Acres affected	0.035
Aesthetic affects	Miles of alternative visible from wilderness areas	0.032
Desert dunes and sand fields habitat	Acres affected	0.029
Business/mining claim affects	Number of mining claims affected	0.026
Ordnance and explosive waste	Potential for encountering	0.023
Mojave creosote bush scrub habitat	Acres affected	0.020
Energy use (construction and operation)	KWh/day, gal/day for storage operations	0.018
Noise	Amount of blasting per alternative	0.009
Common chuckwalla habitat	Number of signs per alternative	0.009
Ribbed cryptantha	Est. number of plants affected	0.009
Traffic/disruption of access	Est. hours cumulative delay	0.009
Borrego milketch	Est. number of plants affected	0.009

a. Project Cost

Overall implementation costs are important to Metropolitan’s customers. Metropolitan is committed to holding costs of its supplies to the lowest levels consistent with maintaining high water quality and system reliability. Overall costs can be measured in terms of capital costs and amortized over the term of the project.

b. On-Line Date

The availability of surplus supplies on the Colorado River Aqueduct is anticipated to decline in the future as Arizona and Nevada take a greater percentage of their allocations. Also, a greater percentage of supply would be dedicated to meeting normal-year needs as demand grows as

projected, as discussed earlier in Section 2. It is, therefore, beneficial to bring storage elements of the project on line as rapidly as possible. A target completion date of December 2000 was set.

c. Risk to Existing Infrastructure

Although it is unlikely that construction and operation of the Cadiz Project would pose a risk to adjacent infrastructure, this risk would be directly proportional to the distance of the project from existing infrastructure. The potential risk can be quantified by the number of miles of each alternative parallel to existing infrastructure (roads, utilities and railroad lines).

d. Proximity to Salt Playas

The soils of salt playas are highly corrosive and require high levels of maintenance. Avoidance of these areas reduces operation and maintenance requirements and operation and maintenance activity along the alternative. A measure to evaluate salt playas is the length of alternative crossing mapped dry lakebeds.

e. Construction Within Sand Dunes

Unstable sands in dune fields pose problems related to construction difficulty, safety and long-term maintenance. These problems are directly proportional to the length of each alternative within sand dune areas.

f. Construction/Maintenance Access

Access to remote construction sites would be difficult and time-consuming. Hauling materials to remote construction sites is a particular problem. Alternatives within reasonable proximity to roads or railroads are preferred. This can be measured in terms of the number of miles an alternative parallels an existing road or railroad.

g. Internal Pipeline Pressure

Alternatives which require greater lift of water, and therefore greater pipeline pressure rating, also require additional measures to ensure against failure. In addition, higher pipeline pressures affect operation and maintenance of the pumping plant. The maximum calculated internal pipeline pressure (head) is a measure of this factor.

h. Arroyo Wash Crossings

Conveyance facilities which crosses desert washes are subject to potential damage from erosive flows during floods. Potential problems are directly proportional to the number of drainage crossings per alternative.

i. Construction in Rock

Construction in hardrock (crystalline) is difficult, slow and a potential safety hazard. The difficulties are directly proportional to the number of miles of construction in rock. These issues are a concern for the pipeline, canal and power distribution facilities.

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j. Right-of-Way Acquisition

Acquisition of rights-of-way can affect construction schedule and cost, and adds uncertainty to the design and construction process. These problems are directly proportional to the number of miles of each alternative in private ownership.

Environmental/Social Measures

Several important factors were not used in this phase of the comparison of alternatives, including the potential for the project to create new access to the desert and adjacent mountain areas. This criterion, while important from the perspective of overall impacts, was considered the same for all four alternatives. Given that the level of new access would be identical for all alternatives, this type of criterion would have no impact on the relative merit of the alternatives.

a. Desert Tortoise

Virtually all the project area is considered to be potential desert tortoise habitat, but the actual occurrence of tortoises differs for each alternative. The number of signs of such occurrences identified during field surveys is a measure of the potential for the project to involve take of this endangered species.

b. Wildlife Movement Corridors Crossed

Wildlife movement corridors could be affected by destruction of habitat or physical obstruction by project facilities. These impacts could affect wildlife species by making habitat areas unavailable for use or by interfering with essential behaviors.

c. Wilderness Area Compatibility

Construction adjacent to a wilderness area may have adverse impacts on wildlife and visitors to wilderness areas as a result of vehicular traffic and construction activity. All of these issues are proportional to the length of each alternative parallel to existing wilderness areas.

d. Air Quality

The proposed project is located in an area which does not currently comply with air quality standards. Air quality may be adversely affected during construction, primarily as a result of emissions from construction equipment and creation of dust. These can be measured in terms of estimated tons of pollutants emitted, using NO_x (nitrates from burning of fuel) and PM₁₀ (a measure of fine dust) as indicators of overall pollution.

e. Mojave Fringe-Toed Lizard Habitat

This species may be impacted directly or indirectly by project construction. The total acres of its habitat affected is a measure of the total potential for each alternative to have such adverse impacts.

f. Cultural/Ethnographic Resources

The region has a number of cultural resources sites, impacts to which can be evaluated based on the number of sites, by type and significance of site. Type of site includes consideration, by alternative, of ethnographic issues.

In addition, the project could unearth (disturb) fossil resources during construction. While this would allow the excavation and study of such fossils, it could also impact the integrity of sites that could be otherwise studied more systematically in the future.

g. Mojave Wash Scrub Habitat

This is an important habitat, providing a relatively complex structure in an intermittently flooded environment for a wide variety of species. These impacts can be estimated by the number of times an alternative crosses such habitat.

h. Aesthetic Affects

The Cadiz Project area is located in a region remote from population concentrations. The pipeline and overhead power lines could potentially be observed by people using adjacent wilderness areas. For these people, seeking to escape the trappings of urban development, a view of water conveyance and overhead power distribution facilities could result in an adverse impact. This impact is directly proportional to the miles of these facilities visible from a wilderness area.

i. Desert Dune and Desert Sand Fields Habitat

Impacts to this habitat can be measured in acres affected by construction.

j. Business/Mining Claim Affects

There is potential that access to mining claims could be temporarily blocked by construction and that the permanent project right-of-way may affect some aspects of such mining claims. The number of such claims per alternative is a useful estimator of these potential problems.

k. Ordnance and Explosive Waste

The general region encompassing the Cadiz Project area has been used as a military training area and there are areas containing unexploded ordnance. This poses a safety threat to construction workers and operation and maintenance personnel. This threat is assumed to be proportional to the total acreage of known target zones crossed by each alternative.

l. Mojave Creosote Bush Scrub Habitat

Impacts to this habitat can be measured in acres affected by construction.

m. Energy Use (Construction and Operation)

Consumption of energy can be calculated for each alternative based on projected equipment use during construction and by estimated electrical power demands of each conveyance facility. The measurement for ongoing project energy use is the projected daily power consumption during storage operations.

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n. Noise

Blasting during construction could create short-term disturbance to people and wildlife. This impact can be measured in terms of the number of days of anticipated blasting for each alternative.

o. Common Chuckwalla Habitat

Potential for impacts to this species can be estimated by the number of sign of the species observed during field studies of each alternative. Such signs are considered an indicator of relative use of the habitat.

p. Ribbed Cryptantha Impacts

Impacts to this rare plant can be estimated based on the number of plants observed during field studies of each alternative.

q. Traffic/Disruption of Access

Each alternative has the potential to cause some construction-related delays in traffic. These can be estimated based on construction routes and construction schedules, combined with analysis of access problems. This analysis would provide an estimate of total hours of delay caused by construction of each alternative.

r. Borrego Milkvetch

Impacts to this rare plant can be estimated based on the number of plants observed during field studies of each alternative.

11.1.3 WEIGHTING OF CRITERIA

The above parameters were weighted to reflect their relative importance in overall decision making for this project. Weighting was based on two factors:

a. Importance of the Parameters

This judgment was based on the potential for each parameter to affect the practicability of the project and/or the acceptability of the project to the public.

b. Usefulness of Parameters in Comparison of Alternatives

Parameters were given a higher weight if they described project characteristics which were significantly different from alternative to alternative.

Highly weighted parameters were both important and represented areas where the various alternatives were significantly different.

11.2 RESULTS OF ALTERNATIVES COMPARISON

11.2.1 GENERAL

Data from field studies for the 27 quantitative measures used in evaluation of the alternatives are summarized on Table 11-2. To rank the four alternatives, these data were entered into a model that first developed a relative “score” for each alternative for each measure, with the score based on the difference between the lowest and highest raw scores on a measure. If all four alternatives had the same raw score on a measure, they were all assigned the same score (a score of 0.0 which eliminates the effect of the measure on alternative evaluation). The rankings thus reflect the relative difference between the alternatives on each measure. The worst score on a measure was then assigned a value of 0.0 and fractional values above this baseline were calculated to reflect the difference in raw score and the weight given to the measure. Where differences are relatively small, such as for acres of Mojave fringe-toed lizard habitat impacted or wilderness area compatibility, the effect of this approach is to assign relatively similar fractional values to all alternatives. Where there are major differences between alternatives, the fractional ranking reflects these differences.

This proportional ranking on a common scale for each measure makes it possible for the results to be entered into a model that (1) accounts for the relative weight given to each measure and (2) then sums the weighted rankings for each alternative for all measures.

In this way, disparate data sets can be converted into a single score for comparison of alternatives. These overall scores are further normalized to a scale of 0.0 to 1.0 by dividing all overall scores by the highest (best) overall score.

The data on Table 11-2 and Figure 11-1 demonstrate that the four alternatives differ most on several measures. First, they differ significantly on four practicality measures, construction completion, risk to infrastructure, construction within sand dunes and construction-maintenance access. The Eastern Alternative has the best raw score on three of these measures, and this is reflected in its overall ranking for practicality as shown on Table 11-3. Second, they differ significantly on desert tortoise effects, on wildlife corridors where any impact is considered significant and on total acres of temporary and permanent habitat impacts. Again, the Eastern Alternative scores high on all these measures. The alternatives do not vary significantly on many of the other measures considered, and the effective weight of these measures with high variation among alternatives is therefore great.

Based on this evaluation, the conclusion of this analysis can be summarized as follows:

- The disadvantages of canals are considerable. They have higher costs than pipeline segments, they block wildlife movement and they have higher habitat impacts. Thus, although the Eastern/Canal Alternative shares some of the advantages of the Eastern Alternative, it has a lower overall ranking because of these disadvantages.
- The Western and Combination alternatives receive a number of low scores on both practicality and environmental impact measures, and they have no significant advantages on high priority measures. The result is a low overall ranking for both of these alternatives.

These conclusions are detailed below.

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**TABLE 11-2
COMPARISON OF ALTERNATIVES
(LISTED IN ORDER OF WEIGHT IN RANKING OF ALTERNATIVES)**

Criteria	Units of Measurement	Project-Level Alternative			
		Eastern	Western	Combination	East/Canal
11. PRACTICABILITY MEASURES					
Project cost	\$ (millions)	150	150	153	165
On-line date	Months beyond target date	0	0	5	5
Risk to infrastructure	Miles adjacent to existing infrastructure	14	11	14	11
Proximity to salt playas	Miles within delineated dry-lakes	14	10	6	15
Construction within sand dunes	Miles within sand dunes	6	14	13	6
Construction maintenance access	Miles away from road or railroad	2	6	6	2
Internal pipeline pressure	Feet (elevation) of head	580	650	655	460
Arroyo wash crossings	Number of crossings	25	25	20	25
Construction in rock	Miles within delineated rock structures	3	3	3	3
Right-of-way acquisition	Miles within private ownership	1.5	2.5	2.25	1.5
12. ENVIRONMENTAL MEASURES					
Desert tortoise	Scat	11	11	11	11
	Active burrows	1	6	6	1
	Old burrows	1	4	5	1
Wildlife corridors crossed	Miles of corridors blocked	0	0	0	0.17
Wilderness area compatibility	Miles of alternative adjacent to wilderness areas	7.35	7.65	7.35	7.35
Air quality	Tons NO _x and PM ₁₀ emissions during construction	49,564	56,248	56,053	84,692
Mojave fringe-toed lizard habitat	Miles of suitable habitat crossed	5.5	7.7	2.7	5.5
Cultural/ethnographic Resources	Historic/pre-historic ethnographic sites/issues	4	1	4	4
	Paleontological resources	-	-	-	-
		-	-	-	-
Mojave wash scrub habitat	Acres affected				
	Temporary	11.5	12.3	13.2	11.0
	Permanent	2.2	2.7	2.8	2.7
Aesthetics affects	Miles of alternative visible from wilderness areas	34	33	34	34
Desert dunes and sand fields habitat	Acres Affected				
	Temporary	148.7	169.9	177.8	130.0
	Permanent	16.5	18.9	19.8	35.2
Business/mining claims affects	Number of mining claims affected	1	1	1	1
Ordnance and explosives waste	Potential for encountering	Medium	Medium	Medium	Medium
Mojave creosote bush scrub habitat	Acres affected				
	Temporary	634.0	650.7	883.7	595.9
	Permanent	465.2	492.8	518.7	505.0
Energy use (construction and operation)	KWh/day, gal/day	187,500	178,600	187,500	129,400
Noise	Amount of blasting	Low	Low	Low	Low
Common chuckwalla habitat	Number of signs	1	2	3	1
Ribbed cryptantha	Est. number of plants affected	306	261	270	306
Traffic/disruption of access	Estimated hours of cumulative delay	100	0	100	100
Borrego milkvetch	Estimated number of plants affected	0	0	0	0

**TABLE 11-3
RELATIVE RANKING OF ALTERNATIVES**

	Overall	Practicability Measures	Environmental and Social Measures
Eastern Alternative	0.99	0.51	0.48
Western Alternative	0.75	0.38	0.36
Combination Alternative	0.49	0.19	0.31
Eastern/Canal Alternative	0.54	0.29	0.25
Alternative Sensitivity Analysis			
	80% of Criteria Weight for Practicability	80% of Criteria Weight for Environmental/Social	0% of Criteria Weight for Cost
Eastern Alternative	0.99	0.97	0.99
Western Alternative	0.76	0.73	0.73
Combination Alternative	0.42	0.57	0.47
Eastern/Canal Alternative	0.56	0.51	0.54

11.2.2 RESULTS

Practicability Scores

The Eastern Alternative is the shortest pipeline, has the fewest secondary facilities (added transmission lines, secondary pumping stations) and has the best construction access of the alternatives. It also has the fewest miles of construction in dunes and desert sands, low risk to existing infrastructure and the best construction access. These features help it achieve the lowest construction cost, about \$8 million less than the Eastern/Canal Alternative, and the best score for completion schedule.

The Western Alternative scores low on essential construction difficulty criteria such as construction in desert dunes and desert sands and construction access. As a result, costs are also marginally higher and there is a greater risk of failing to meet completion schedule criteria.

The Combination Alternative has lowest scores on five practicality criteria, including project cost. Cost and completion schedule, however, are the primary factors which cause its low practicability score. In addition, it scores low on a number of factors such as proximity to salt playas and arroyo wash crossings, albeit marginally lower.

The Eastern/Canal Alternative, while it shares many of the advantages of the Eastern Alternative, scores low on schedule and cost because the canal section requires two secondary pumping stations and adds to the construction schedule.

Environmental and Social Impact Scores

The Eastern Alternative has the highest net score on the 17 environmental/socioeconomic criteria, primarily based on its low impacts to the desert tortoise. The Western and Combination Alternatives have high desert tortoise impacts as a result of the southern power transmission line. The Combination Alternative has higher habitat impacts. The Eastern/Canal Alternative has higher impacts on corridor movement and lower scores on a number of other criteria.

An additional environmental criteria was identified following review of the Draft EIR/EIS to reflect land use impacts. The number of miles of Multiple-Use Class L impacted by each of the alignments was measured as follows:

**TABLE 11-4
MILES WITHIN
CDCA LAND-USE CLASSES**

Alternative	CDCA Plan Land Use Classes	
	L – limited	M – moderate
Eastern	5	30
Western	17	16
Combined	15	19
Eastern/Canal	5	30

Sensitivity Analyses

Purpose of Sensitivity Analyses

To determine whether the weighting of criteria introduced a significant bias into the analysis of conveyance alternatives, the overall weighting of practicability and environmental/social parameters was varied and scores recalculated. Three sensitivity analyses were conducted, as outlined below.

a. Increase Overall Weight for Practicability Parameters

This sensitivity test involved increasing the weight of the practicability parameters as a group from 50 percent to 80 percent, with a corresponding decrease in the weight given to environmental/social impact parameters as a group to 20 percent.

b. Increase the Overall Weight for Environmental/Social Impacts Parameters

This sensitivity test involved increasing the weight of the environmental/social impact parameters as a group from 50 percent to 80 percent, with a corresponding decrease in the weight given to practicability parameters as a group to 20 percent.

c. Reduce the Weight of the Cost Parameter

To determine whether the high weight given to project costs was affecting overall evaluation, the weight of this parameter was reduced to zero. The weight given to all other parameters was then increased proportionally to equal 1.0.

Results of Sensitivity Analyses

Because the Eastern Alignment scores well for both practicality and environmental impacts, increasing the weight of practicability measures or the weight of environmental/social impact measures does little to change the overall rankings of the four alternatives. The Eastern Alternative remains the preferred alternative and the environmentally preferred alternative under both sensitivity tests. Note in Table 11-3 and Figure 11-1 that the ranking for the Combination Alternative is affected by changing these weights. When practicality is emphasized, this alternative's total ranking

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decreases. When environmental/social impacts are emphasized, the Combination Alternative's ranking increases. These changes are not significant to change the overall ordering of the alternatives.

Decreasing the weight of the cost measure has virtually no impact on overall rankings of the alternatives because anticipated project costs vary by less than ten percent (\$150 to \$165 million) among the alternatives.

It is clear, then that the overall rankings of the alternatives are not sensitive to changes in the weight given to each category of measures, or to the highest weighted practicality measure. In addition, because the Eastern Alternative scores well on many of the other high priority measures, it is highly unlikely that changing the weight on these measures would alter the overall rankings.

11.3 SELECTION OF THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

The primary criteria for selection of the environmentally preferred alternative were impacts to desert tortoise and wildlife corridors, and wilderness area compatibility. These were the three highest-weighted evaluation criteria. These were addressed individually and overall rankings of the alternatives are discussed below.

11.3.1 IMPACTS TO DESERT TORTOISE

Desert tortoise might be found near any of the Cadiz Project alternatives. A total of eight tortoise burrows and numerous other (15 to 16) signs were found in the Western and Combination alternatives, respectively, particularly along the powerlines between Iron Mountain Pumping Plant and the Cadiz Pumping Plant. Only four burrows and 11 other signs were found along the Eastern Alternative. The Eastern/Canal Alternative would, however, have significantly higher impacts on desert tortoise because an open canal section, would be constructed through this species habitat at the southeast corner of the Iron Mountains. This fenced canal section would draw predators to the area and block movement of desert tortoise, big horn sheep and other wildlife across a movement corridor.

11.3.2 IMPACTS TO WILDLIFE CORRIDORS

The Western and Combination alternatives cross a 10-mile wide wildlife movement corridor between the Iron Mountains and the Calumet Mountains. In contrast, the Eastern Alternative crosses a similar wildlife movement corridor from the Old Woman Mountain area to the Iron Mountains, but the length of crossing is only five miles. Both short-term construction impacts to wildlife movement and long-term impacts as a result of routine inspection and maintenance of pipelines and power lines would therefore be lower for the Eastern Alternative. In addition, the Eastern/Canal Alternative would effectively sever the movement corridor between the Iron Mountains and the Old Woman Mountain Wilderness Area, with potentially significant long-term implications for wildlife.

11.3.3 WILDERNESS AREA COMPATIBILITY

Although all alternatives would probably be visible from nearby wilderness areas during construction, and power distribution lines would be visible from many areas in the long term for all alternatives, the Eastern Alignment has the lowest potential for conflicts with these areas. All alternatives include approximately five miles of construction adjacent to the northeastern boundary of the Cadiz Dunes Wilderness Area. In addition, the Eastern Alternative and Combination alternatives lie within three miles of the Old Woman Mountains Wilderness Area for a one mile

segment, but are otherwise relatively distant from designated wilderness areas. In contrast, the Western Alternative has a three-mile segment along the eastern boundary of the Cadiz Dunes Wilderness Area. The Eastern/Canal Alternative would be a visible intrusion into the landscape, visible from the Iron Mountains, the valley floor and the Old Woman Mountains Wilderness Area.

11.3.4 OTHER ENVIRONMENTAL IMPACTS

As Tables 11-2 and 11-3 indicate, the Eastern Alternative has relatively lower combined impacts (higher scores) in most other environmental, social and cultural resources categories than the other alternatives. Given the Eastern Alignment's low level of impacts to all three critical environmental criteria, and no offsetting high impacts on other criteria, the Eastern Alternative was therefore designated the environmentally preferred alternative. The No Project Alternative is not the environmentally preferred alternative because, while it would minimize project area environmental and social impacts, it would generate its own adverse environmental and social impacts. This is because it would result in water supply deficits and rationing during future droughts. Rationing has adverse short-term impacts on the environment associated with potential groundwater overdrafting within Metropolitan's service area, resulting in lowering of groundwater levels and salinity intrusions. Rationing would affect agricultural production and land use and impact landscaping at public parks and recreation areas due to reduced irrigation. Significant short-term economic impacts are also associated with rationing.

11.4 SELECTION OF THE PREFERRED ALTERNATIVE

The preferred alternative is the alternative which best optimizes practicability and environmental impacts; that is, which has relatively high practicability combined with acceptable levels of impact.

As Tables 11-2 and 11-3 suggest, the environmentally preferred Eastern Alternative also has the highest practicability score, and this score is not affected by changing the overall weight given to practicability and environmental/social scores as shown on Figure 11-1. The Eastern Alternative, therefore, would be preferred for practicability and low environmental impacts. In addition, it had the least impact on land use, as reflected in the number of miles of Multiple Use Class L land affected. It was therefore designated as the preferred alternative.