FIGURE VI-1: MANAGEMENT STRATEGY FOUR (MS-4)—NEBRASKA WATER TRANSFER SCHEME 1

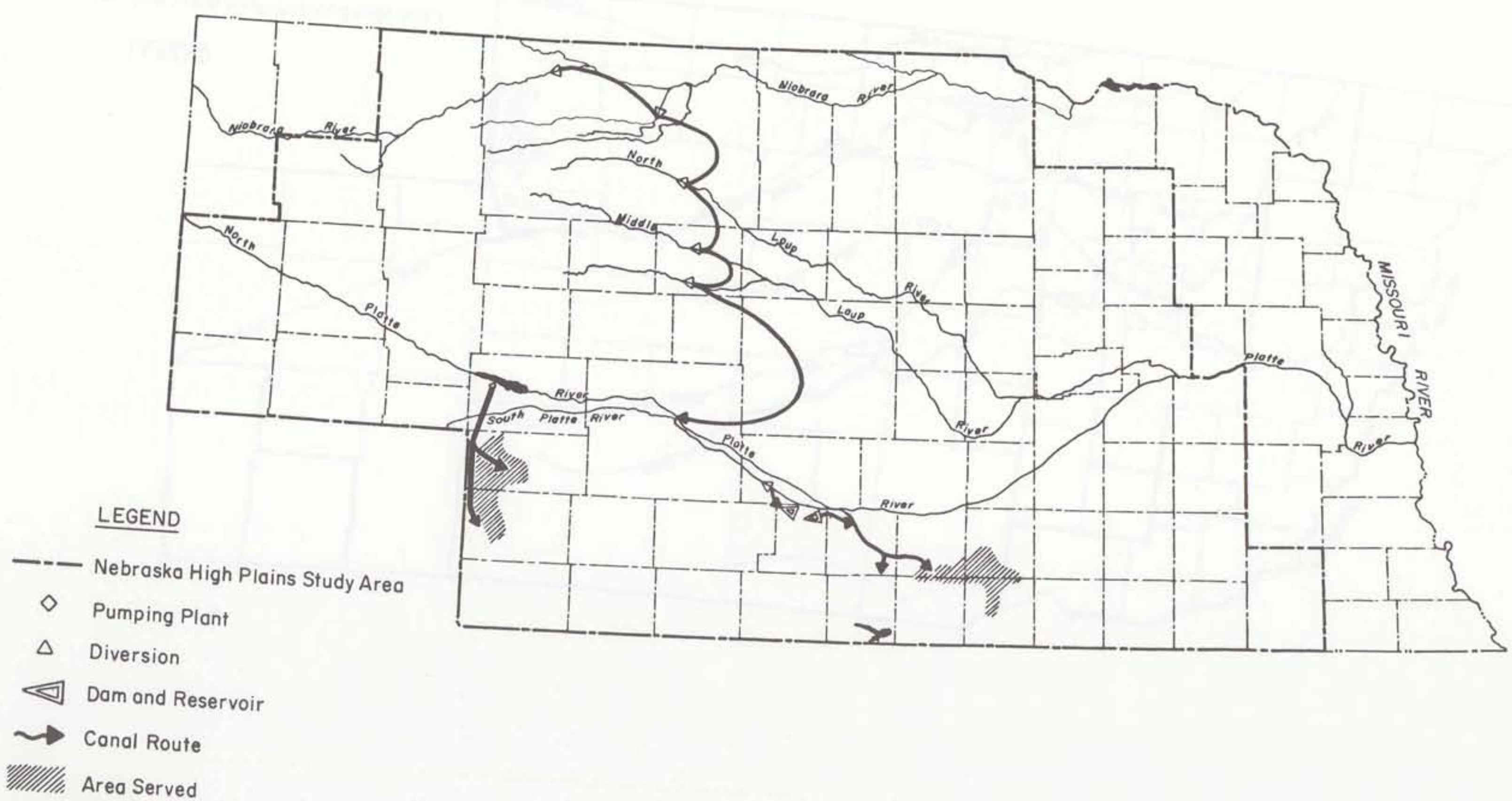


FIGURE VI-2: MANAGEMENT STRATEGY FOUR (MS-4)—NEBRASKA WATER TRANSFER SCHEME 2

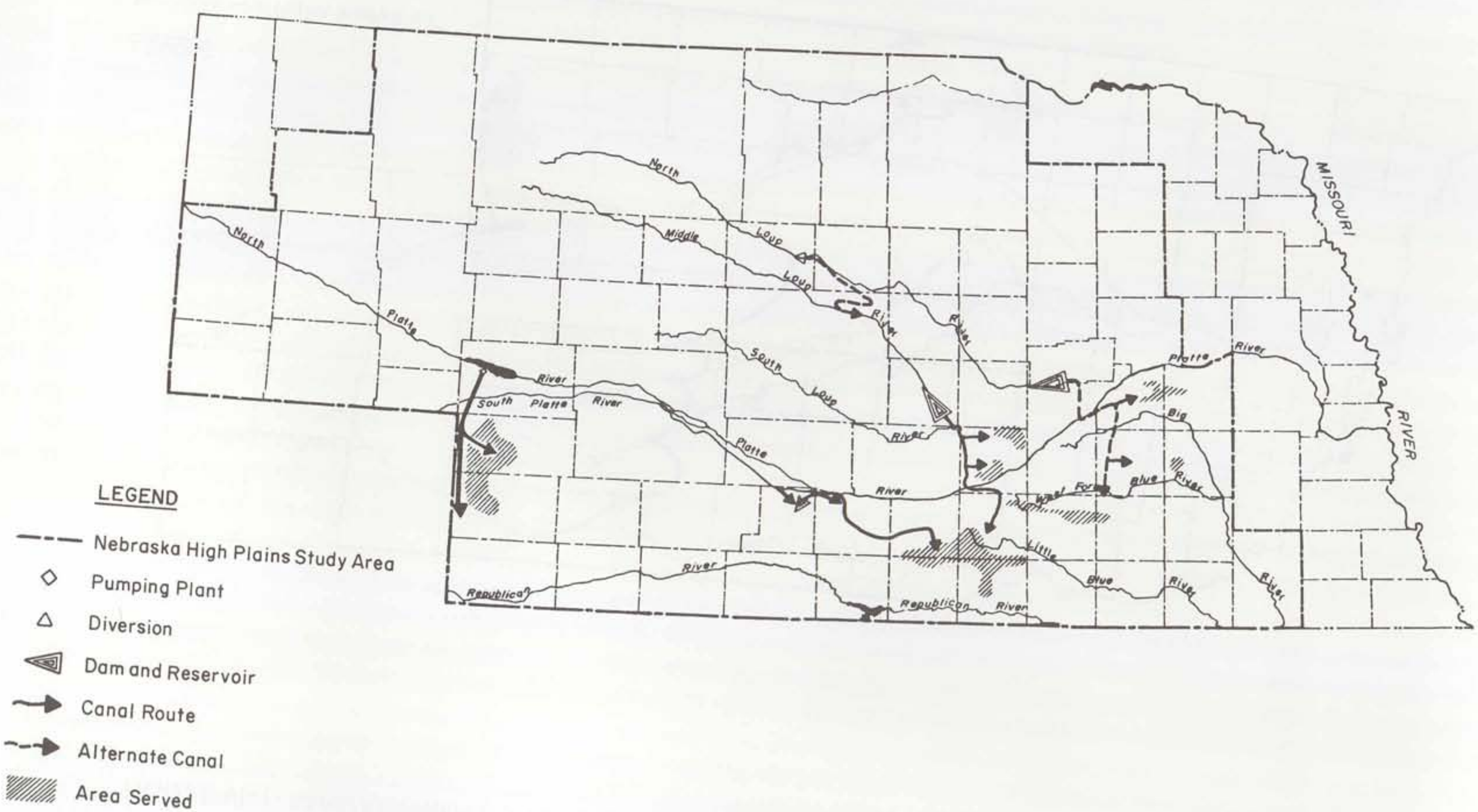


FIGURE VI-3: MANAGEMENT STRATEGY FOUR (MS-4)—NEBRASKA WATER TRANSFER SCHEME 3

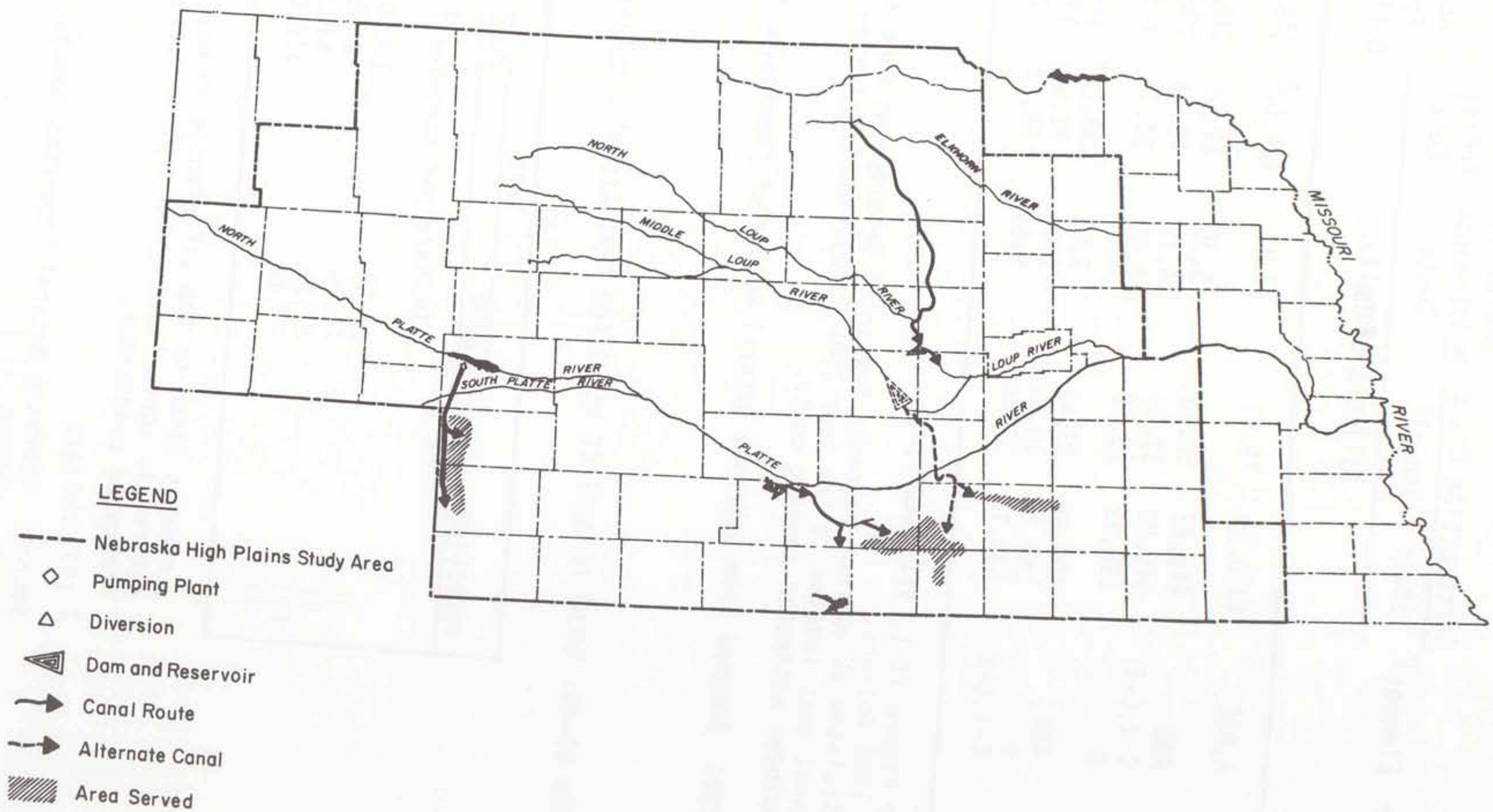


Table VI-44: PRELIMINARY ESTIMATES OF COSTS OF WATER UNDER NEBRASKA INTERBASIN TRANSFER SCHEMES

Transfer Scheme	Element[1]	Construction Costs Total[2]	Construction Costs Annual[3]	Operation & Maintenance Costs	Annual Cost[4]	Acre-Feet Delivered	Annual Cost Per Acre-Foot Dollars
		Millions of Dollars					
1	A,B&C	1378.09	79.90	10.33	124.62[5]	345,000	361.25
	A&B	446.62	25.90	3.35	42.55	205,000	207.56
	C-1,C-2	549.86	31.88	4.12	47.79	200,000	238.87
	D	398.72	23.12	2.99	34.73	125,000	277.81
3	A&B	403.96	23.42	3.03	38.28[5]	145,000	263.98
	B	260.16	15.08	1.95	22.65	120,000	188.75
	C-1,C-2	645.77	37.44	4.84	56.23	75,000	749.73

1 See Figure VI-1, VI-2 and VI-3.
2 In 1980 dollars.
3 Calculated at current Nebraska Resources Development Fund rate, 5 3/8 percent.
4 Annual cost indexed to the year 2000 (projected completion date).
5 Includes estimated pumping costs.

Source: Adapted from Nebraska Natural Resources Commission Report

Table VI-45: VALUE OF SURFACE WATER FOR IRRIGATION[1] - NEBRASKA

SUBREGION	YEAR 2000	YEAR 2020
	Dollars per acre-foot[2]	
I	83.80	105.03
II	76.79	94.83
III	67.29	83.29
IV	87.32	116.01

1 Estimates based on the differences in net returns to agriculture under dryland versus irrigated conditions.

2 1977 dollars

Source: Nebraska Natural Resources Commission Report

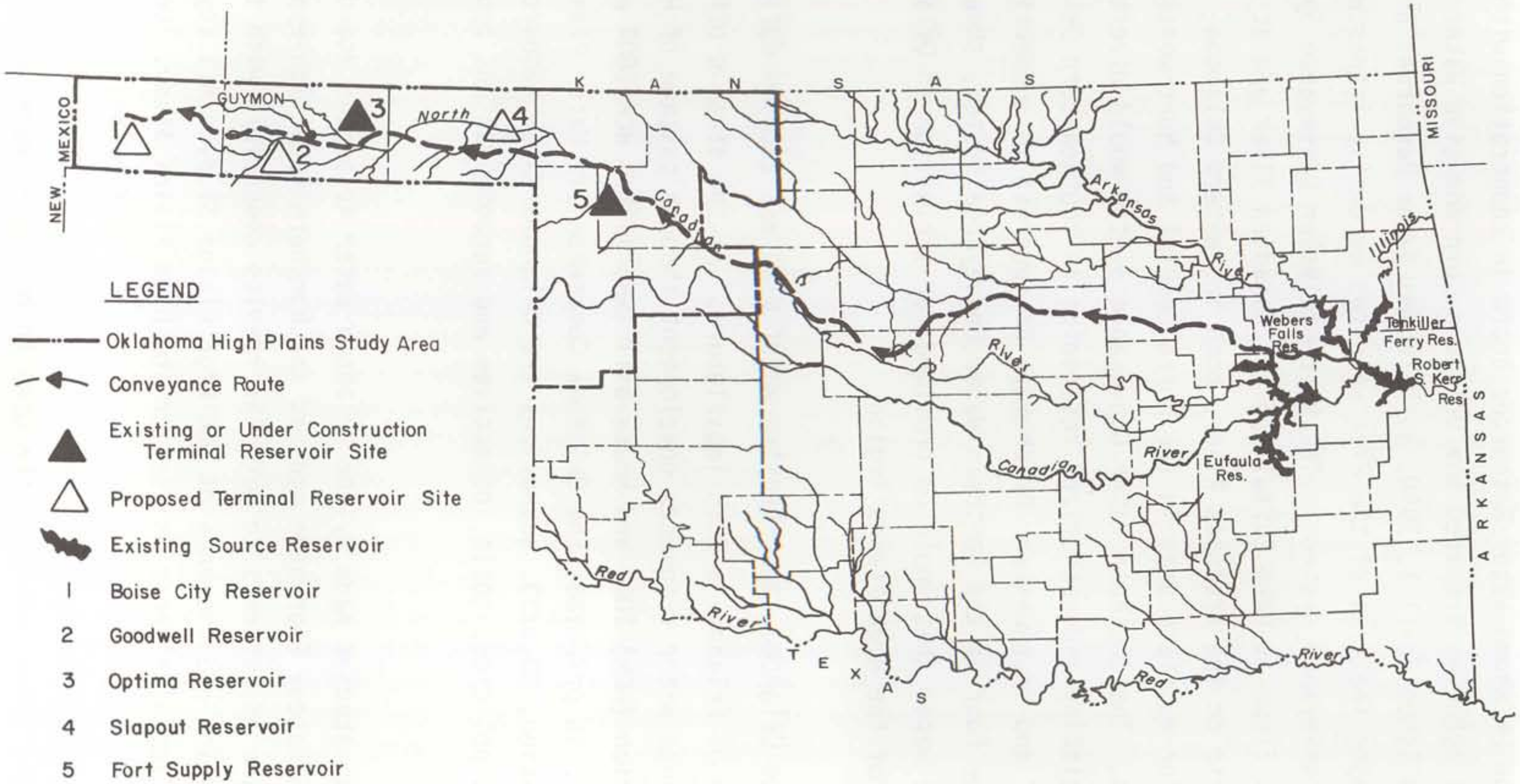
Oklahoma

The Oklahoma Water Resources Board in cooperation with other state and federal agencies prepared the Oklahoma Comprehensive Water Plan Report which was published April 1, 1980, as Oklahoma Water Resources Board Publication 94. Major features of the Plan were two extensive intrastate interbasin water conveyance systems. The Northern Water Conveyance System would divert surplus flows at Lake Eufaula on the Canadian River and at Robert S. Kerr Reservoir on the Arkansas River, both in eastern Oklahoma, and convey the water for multiple uses in the North Central and Northwestern Planning Regions. The Southern Water Conveyance System would divert surplus yields from existing and authorized reservoirs in southeastern Oklahoma for uses in central and southwestern Oklahoma. Of interest in connection with Management Strategy Four is the Northern Water Conveyance System, shown on Figure VI-4, and the water that would be provided for irrigation in Oklahoma Subregions I and II of the High Plains Region.

The Oklahoma comprehensive water plan was adopted during the first session of Oklahoma's 38th legislature. As the state's official guide to long-range water resources development through passage of House Concurrent Resolution (HCR) 1004 and House Bill (HB) 1139. HCR 1004 accepts, adopts and approves in principal the Oklahoma Comprehensive Water Plan. Its companion legislation, HB 1139, authorizes the Oklahoma Water Resources Board to carry out the policies, goals, objectives and recommendations contained in the Plan.

The studies made by the Oklahoma Water Resources Board of Management under Strategy Four have updated the Northern Water Conveyance System with necessary adjustments to make the results compatible with the reporting and aggregating requirements of the High Plains Study. All key assumptions were reconciled with those in use for the High Plains Study. Delivery costs of imported water were not accounted for but on-farm distribution costs and costs of pumping from a 10-foot depth were included. Allocations of costs among the areas and among the uses to be served were not made by the Board.

FIGURE VI-4: MANAGEMENT STRATEGY FOUR (MS-4)—OKLAHOMA NORTHERN WATER CONVEYANCE SYSTEM



The Northern Water Conveyance System as updated would deliver about 800,000 acre-feet per year to Oklahoma Subregion I and approximately 52,000 acre-feet per year to Subregion II. Construction costs for the entire northern system would total $5.3 billion in terms of 1978 dollars, over a 30-year construction period.

Results of the Board's analyses of the effects on Oklahoma Subregions I & II due to implementation of Management Strategy Four and comparisons with other Management Strategies are presented on Tables VI-46, 47, 48 and 49.

Irrigation water use under Management Strategy Four would be substantially greater than under the Baseline--twice as much in year 2000 and 90 percent greater in 2020. These amounts are greater than for any of the other management strategies evaluated (Table VI-46). Correspondingly, irrigated acres would increase significantly, 77 percent by year 2000 and 74 percent by 2020, as compared to the Baseline, with dryland acres decreasing by about the same amounts so that the total harvested acres remain nearly constant (Table VI-47). Production of food and feed grains and alfalfa would increase significantly as contrasted to the Baseline (Table VI-48) with corresponding estimated net returns increasing 58 percent for year 2000 and 53 percent for 2020 (Table VI-49).

Cost Estimation

An additional cost associated with the water transfer alternatives not presented in this section relates to water distribution costs from the terminal reservoirs to the farm headgates. Distribution system capital costs from the terminal reservoirs to farm headgates, estimated at about $2,150 per irrigated acre, are based on studies by the U.S. Bureau of Reclamation for the Oklahoma Comprehensive Water Plan.

Environmental Effects*

Alternative Strategy Four--Applicable only to Nebraska and Oklahoma. Could result in both positive and negative effects although weighted toward

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* Excerpted from U.S. Fish & Wildlife Service Report, November, 1981.

Table VI-46: ESTIMATED TOTAL IRRIGATION WATER USE FOR BASELINE AND STRATEGIES ONE, TWO, FOUR, AND FIVE, OKLAHOMA HIGH PLAINS AREA 2000 AND 2020

YEAR	2000	2020
	---(1,000 acre/feet)---	
Baseline	795	820
MS-1	645	600
MS-2	425	380
MS-4	1,500	1,460
MS-5a	1,030	930
MS-5b	680	600

Source: Adapted from Oklahoma Water Resources Board

Table VI-47: IRRIGATED, DRYLAND AND TOTAL HARVESTED ACRES, BASELINE AND MANAGEMENT STRATEGY FOUR, BY SUBREGION, OKLAHOMA HIGH PLAINS AREA, 2000 AND 2020

	Year 2000		Year 2020	
	Baseline	MS-4	Baseline	MS-4
SUBREGION 1				
Irrigated	358,838	637,894	390,513	686,427
Dryland	545,684	269,246	517,893	224,661
Subtotal	904,522	907,140	908,406	911,088
SUBREGION 2				
Irrigated	33,302	57,677	35,281	54,565
Dryland	407,600	387,600	405,634	390,485
Subtotal	440,902	445,277	440,915	445,050
TOTAL				
Irrigated	392,140	695,571	425,794	740,992
Dryland	953,284	656,846	923,527	615,146
Subtotal	1,345,424	1,352,417	1,349,321	1,356,138

Source: Adapted from Oklahoma Water Resources Board

Table VI-48: ESTIMATED TOTAL PRODUCTION, BASELINE AND MANAGEMENT STRATEGY 4, OKLAHOMA HIGH PLAINS AREA, 2000 and 2020

		Year 2000		Year 2020	
		Baseline	MS-4	Baseline	MS-4
		(1,000 units)			
Food & Feed Grains	bu.	76,550	96,152	89,421	113,978
Alfalfa	T.	290	565	296	562
Silage	T.	680	680	790	748

Source: Adapted from Oklahoma Water Resources Board

Table VI-49: ESTIMATED NET RETURNS TO OKLAHOMA HIGH PLAINS AREA FOR BASELINE, MANAGEMENT STRATEGIES ONE, TWO, FOUR AND FIVE 2000 AND 2020

	Year 2000	Year 2020
	(1,000's of 1977 $)	
Baseline	48	69
MS-1	50	72
MS-2	48	67
MS-4	76	105
MS-5a	65	90
MS-5b	60	80

Source: Adapted from Oklahoma Water Resources Board latter. Depletion of source streams and those below reservoirs, coupled with loss of riparian habitat, are greatest concerns.

° Source Facilities--Large quantities of water withdrawn from source streams could result in reduced aquatic habitat quality. Downstream riparian resources could be negatively impacted due to lowered water availability.

° Holding Reservoirs--Would inundate large areas or riparian and stream habitats, eliminating their value to important fish and wildlife species.

° Conveyance Facilities--Could block migration and movement patterns. Individual animals could be trapped in open canals. Use of some streams to convey water in Nebraska and Colorado could provide localized benefits.

° Terminal Reservoirs--Inundation of large acreages of stream and riparian habitats would negatively impact valuable resources. Without adequate releases, downstream aquatic and riparian resources would be negatively affected as well. Terminal reservoirs could create aquatic habitats within semi-arid area, but fluctuating water levels would render management largely ineffective.

Institutional Implications

Only Nebraska and Oklahoma, as part of the state research for the Study, have evaluated potential intrastate interbasin transfer schemes.

Water importation to restore irrigation lands going dry or to replenish ground water resources being depleted have long been considered in certain sections of Nebraska. Legal barriers to interbasin transfers were finally removed in 1980 when the Nebraska Supreme Court ruled that interbasin transfers were valid, overturning an earlier court decision. In Little Blue Natural Resources District v. Lower Platte North Natural Resources District, 206 Neb. 535 (1980), the court held that the State Constitution and statutes permitted interbasin transfers but required the Director of the Department of

Water Resources, who must approve water rights applications, to determine whether the proposed transfer is in the public interest. Legislation was enacted in 1981 delineating factors to be considered by the Director when evaluating an application for an interbasin transfer of water (Neb. Rev. Stat. §§46-288 and -289).

Those factors include, but are not limited to:

- The economic, environmental, and other benefits of the proposed interbasin transfer and use.
- Any adverse impacts of the proposed interbasin transfer and use.
- Any current beneficial uses being made of the unappropriated water in the basin of origin.
- Any reasonably foreseeable future beneficial uses of the water in the basin of origin.
- The economic, environmental, and other benefits of leaving the water in the basin of origin for current or future beneficial uses.
- Alternative sources of water supply available to the applicant.
- Alternative sources of water available to the basin of origin for future beneficial uses.

Local Natural Resources Districts (NRD's) in Nebraska are among the possible sponsoring entities for these large-scale types of water projects in the state. They possess the authority to develop, store, and transport water for beneficial uses (Neb. Rev. Stat. §2-3238) and to construct and maintain such projects as dams, reservoirs, dikes, levees, drainage and channel rectification projects (Neb. Rev. Stat. §§2-3267). The Commission does not, however, have the authority to build the projects on its own.

The financial ability of most NRD's to fund these projects is rather limited. Each NRD has authority to levy a tax of not to exceed three and five-tenths cents on each one hundred dollars of actual valuation annually on all of the tangible, taxable property within the NRD to be used for the operation of the NRD (Neb. Rev. Stat. §2-3225). This amounts to a range of maximum income receipts from this source of approximately $114,695 (low) to $2,984,193 (high) during fiscal year 81-82. A higher levy could be authorized by a majority vote of those voting on the issue at a regular election on a referendum question submitted by a resolution of the NRD Board of Directors (Neb. Rev. Stat. §2-3225). The NRD could, in addition, issue revenue bonds to finance construction of facilities (Neb. Rev. Stat. §2-3226).

NRD's also have the ability to contract to furnish financial or other aid for the carrying out of projects for the benefit of the district (Neb. Rev. State. §2-3235). They may fix the rates for furnishing water (Neb. Rev. State. §2-3238) and levy assessments against lands within the district to which water service is furnished (Neb. Rev. Stat. §2-3239).

Finally, an NRD can establish an improvement project area for projects or portions of projects which the NRD Board of Directors determines to be of special benefit to a certain area within the district. The cost of these improvement projects may be recovered by the board by special assessment (Neb. Rev. Stat. §2-3252). The board must hold a hearing on the establishment of an improvement project area. If the project does not result in revenue-producing continuing services, the board shall apportion benefits (Neb. Rev. Stat. §2-3254) and may issue improvement project area bonds to pay the cost of the special benefit portion (Neb. Rev. Stat. §2-3254.02).

Other entities could also be formed to sponsor these types of projects, such as reclamation districts (Neb. Rev. Stat. §46-501 et seq.) and irrigation districts (Neb. Rev. Stat. §46-101 et. seq.).

Oklahoma--The Oklahoma Legislature has adopted the Oklahoma Comprehensive Water Plan as a flexible guide to long-range water development. A funding mechanism with the potential to help finance short-term and long-term water resources needs is being considered by the second session of Oklahoma's

38th legislature. If passed, the bill would divert a portion of Oklahoma's gross production tax revenue into a "Statewide Water Development Revolving Fund" thus providing a mechanism to fund water development projects throughout the state and assist communities in obtaining adequate water supplies.

To carry out a transfer plan, legislative enactments to establish policies and provide adequate authorities for the Oklahoma Water Resource Board, or other state agency, generally similar to those outlined above for Nebraska, would be necessary. Local water management districts would need to be established with adequate powers to assume responsibility for local distribution and management of transferred water in conjunction with local surface and ground water supplies, and to collect taxes and/or water charges for repayment of allocated costs.

Participation by the United States--If federal participation is sought for intrastate interbasin transfer plans, the plans must take federal policies into account. Specific projects would have to be individually authorized and funded by Congress pursuant to current congressional authorities and procedures.

MANAGEMENT STRATEGY FIVE

Pursuant to the legislation authorizing the High Plains-Ogallala Aquifer Regional Resources Study, the U.S. Army Corps of Engineers conducted the study of potential interstate, interbasin transfers of water to terminal reservoirs in the High Plains Region for irrigation. The Corps was assisted by the U.S. Fish and Wildlife Service which assessed the impacts on fish and wildlife resources at the points of diversion, the conservation storage reservoirs, along the conveyance routings (canals, siphons, pipelines, pumping plants, river crossings), and at the terminal reservoirs. The environmental assessment did not extend downstream of the points of diversion along the source streams. Responsibility for overall direction and preparation of the final report on the Corps' study was assigned by the Chief of

Engineers to the Southwestern Division. The Omaha District, Kansas City District, Tulsa District and Fort Worth District of the Corps made the studies of specific transfer possibilities.

The High Plains Study Council provided policy direction for the Corps' studies by Resolution No. 6*. The resolution states, in effect, that the states and basins of origin, both upstream and downstream of a potential point of diversion for an interstate, interbasin transfer, shall be considered to have prior rights to the waters involved in perpetuity as against the importing areas, for all existing and future beneficial uses both instream and consumptive. Thus, only "surplus" water would be considered available for transfer.

In working with the states through the Council's State Liaison Committee, a plan evolved for examining the impacts of such transfers in terms of two sub-alternatives:

- ° Management Strategy Five-A (MS-5A) - restoration of irrigation on lands where ground water has been physically exhausted under Management Strategy One during the Study period. Water utilization rates were projected as those which would be characteristic under Strategy One whether water applied was drawn from ground water or import water.

- ° Management Strategy Five-B (MS-5B) - amount of imported water required for restoration of irrigation on lands where the Aquifer is exhausted under Management Strategy Two, imported water applied at Management Strategy One use rate.

These levels of importation were selected by the Liaison Committee as an equitable means of distributing a limited import supply while meeting the Study charge to maintain agricultural production on the High Plains. Because the Liaison Committee found Strategy Five-A more plausible than Five-B, Five-A is discussed in greater detail here.

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* See Chapter Three.

The acreages which would be supplied with import water are:

	MS-5A (acres)	MS-5B
Colorado	160,000	145,000
Kansas	715,000	540,000
Nebraska	2,100,000	1,510,000
New Mexico	185,000	125,000
Oklahoma	250,000	195,000
Texas	1,200,000	945,000

The General Contractor provided input to the Corps studies concerning import water demand and intra-seasonal variations in demand for irrigation water. The General Contractor also provided information concerning potential future stream depletion above the points of diversion being considered, derived from studies made by others.

The Corps did not make any findings as to the amounts of water that might be considered as "surplus" and thus available for transfer to the High Plains Region. Rather, the Corps made reconnaissance level designs and cost estimates for ranges of transfer quantities.

The Corps Southwestern Division's Final Report, "Water Transfer Elements of High Plains-Ogallala Aquifer Study" was completed as a review draft in February 1982; with the individual District office reports as appendices. The following discussion of the Corps transfer studies and results is excerpted from the Corps' report. Following that, the results of the studies made by the states and General Contractor of the economic impacts of intra-state, interbasin transfers are presented in relation to Management Strategy Four.

Transfer Alternatives

The Corps initially examined a considerable number of possible points of diversion on source streams, conservation storage reservoir possibilities at or near the points of diversion, alternative conveyance routings and facilities, and terminal storage reservoir possibilities. With the concurrence of the High Plains Study Council, through its Resolution No. 8, April 17, 1980, four alternatives, hereinafter termed routes, were selected for further study*, namely:

- Route A: source, Missouri River at Fort Randall, South Dakota; route, southwestward through Nebraska to terminal storage at Bonny Reservoir, Colorado.

- Route B: source, Missouri River near St. Joseph, Missouri; route, southwestward through Kansas to terminal storage on the Arkansas River near Dodge City, Kansas.

- Route C: sources, White River at Clarendon, Arkansas; Arkansas River at Van Buren, Arkansas; Ouachita River at Camden, Arkansas; Red River at Fulton, Arkansas; Sulphur River at Darden, Texas, and Sabine River at Tatum, Texas; route, west and northwest across Oklahoma into the Panhandle of Texas to terminal storage on the Canadian River near Canadian, Texas.

- Route D: sources, White River at Clarendon, Arkansas; Arkansas River at Pine Bluff, Arkansas; Ouachita River at Camden, Arkansas; Red River at Fulton, Arkansas; Sulphur River at Darden, Texas and Sabine River at Tatum, Texas; route, westward through Texas to terminal storage at Bull Lake, near Littlefield, Texas (subsequently replaced by Blanco Canyon near Crosbyton, Texas).

These routes are shown in generalized form on Figure VI-5, and in more detail on Figures VI-7, VI-8, VI-9 and VI-10, respectively, taken from the Corps Final Report. Two alternative routes across Kansas are shown on Figure VI-8.

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* The routes and sources presented were approved by the High Plains Study Council for this analysis by the Corps of Engineers in April 1980. They provide for the High Plains Study a range of potentials that could be further evaluated under Strategy Five. The availability of water for diversion from these sources has not been confirmed by the states of origin.

FIGURE VI-5: MANAGEMENT STRATEGY FIVE (MS-5)—INTERSTATE WATER TRANSFER ROUTE ALTERNATIVES ASSESSED BY THE CORPS OF ENGINEERS

Source: Adapted from Figure 5, Review Draft, Water Transfer Elements of High Plains-Ogallala Aquifer Study, January 1982, U.S. Army Corps of Engineers

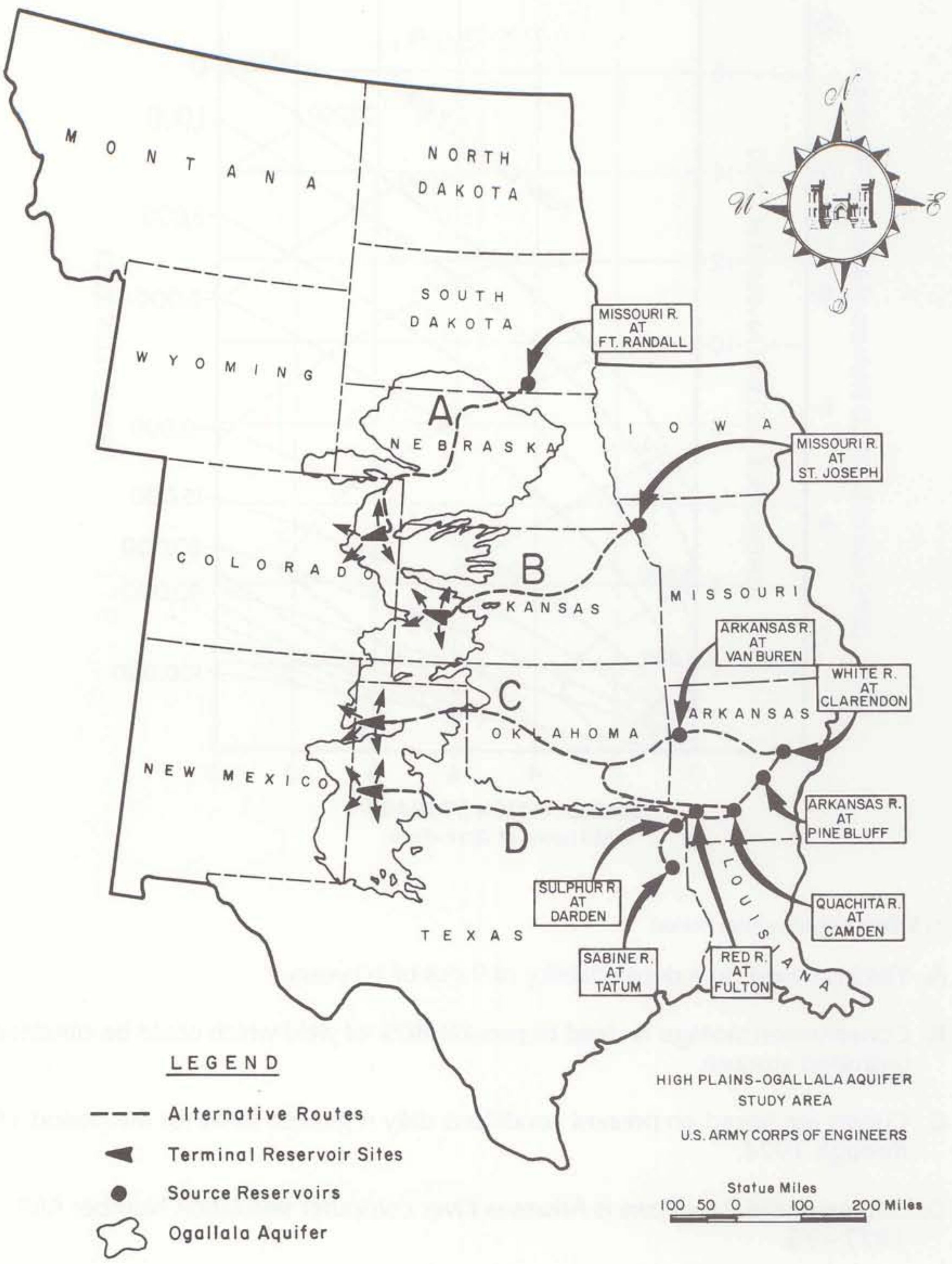
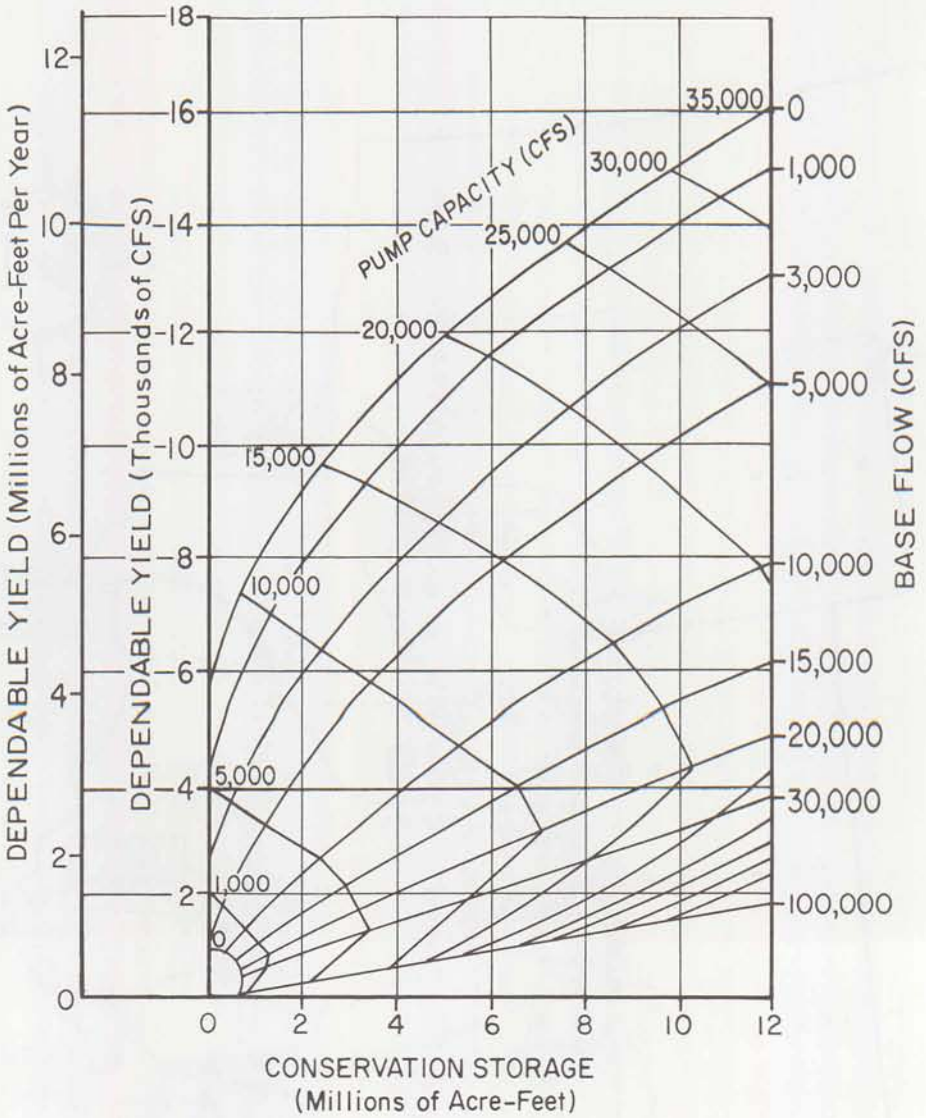


FIGURE VI-6: MANAGEMENT STRATEGY FIVE (MS-5)—POTENTIAL WATER TRANSFER TO THE HIGH PLAINS REGION FROM ARKANSAS RIVER AT VAN BUREN, ARKANSAS—YIELD CURVES BY CORPS OF ENGINEERS

Source: Adapted from Figure 12, Review Draft, Water Transfer Elements of High Plains-Ogallala Aquifer Study, January 1982, U.S. Army Corps of Engineers



*15 Year Construction Period

A. Yield is based on a dependability of 9 out of 10 years.

B. Conservation storage is sized to provide 80% of yield which could be obtained from unlimited storage.

C. Curves are based on present conditions daily regulated flows for the period 1940 through 1974.

D. Source of the daily flows is Arkansas River computer simulation Number ARK 1977–35.

E. Conservation storage assumed empty initially.

FIGURE VI-7: MANAGEMENT STRATEGY FIVE (MS-5)—ALTERNATIVE ROUTE "A", NEBRASKA AND N.E. COLORADO/N.W. KANSAS, WITH SOURCE AND TERMINAL RESERVOIR SITES—U.S. ARMY CORPS OF ENGINEERS

Source: Adapted from Figure 13, Review Draft, Water Transfer Elements of High Plains-Ogallala Aquifer Study, January 1982, U.S. Army Corps of Engineers

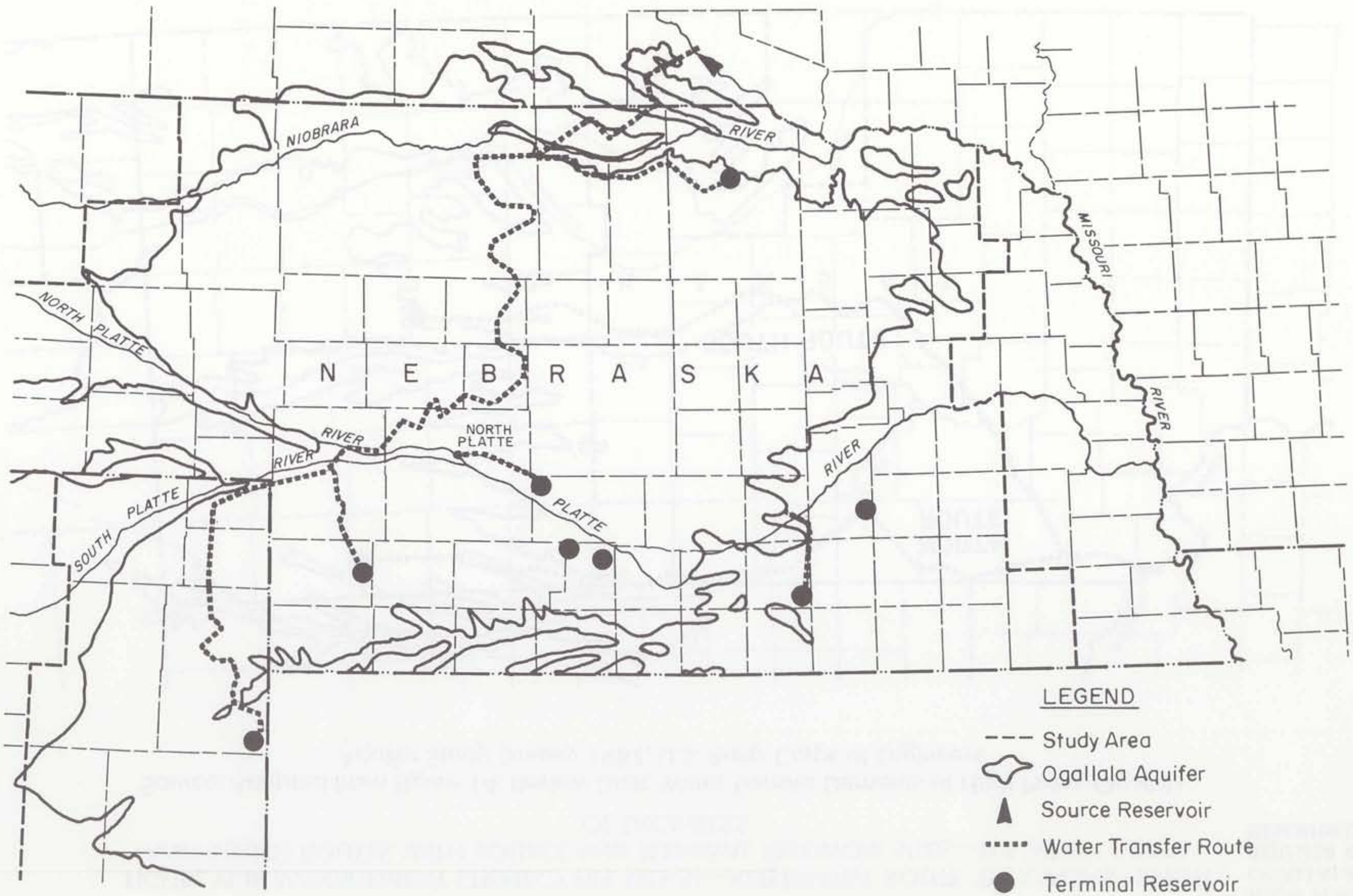


FIGURE VI-8: MANAGEMENT STRATEGY FIVE (MS-5)—ALTERNATIVE ROUTE "B", KANSAS NORTH AND SOUTH ROUTES, WITH SOURCE AND TERMINAL RESERVOIR SITES—U.S. ARMY CORPS OF ENGINEERS

Source: Adapted from Figure 14, Review Draft, Water Transfer Elements of High Plains-Ogallala Aquifer Study, January 1982, U.S. Army Corps of Engineers

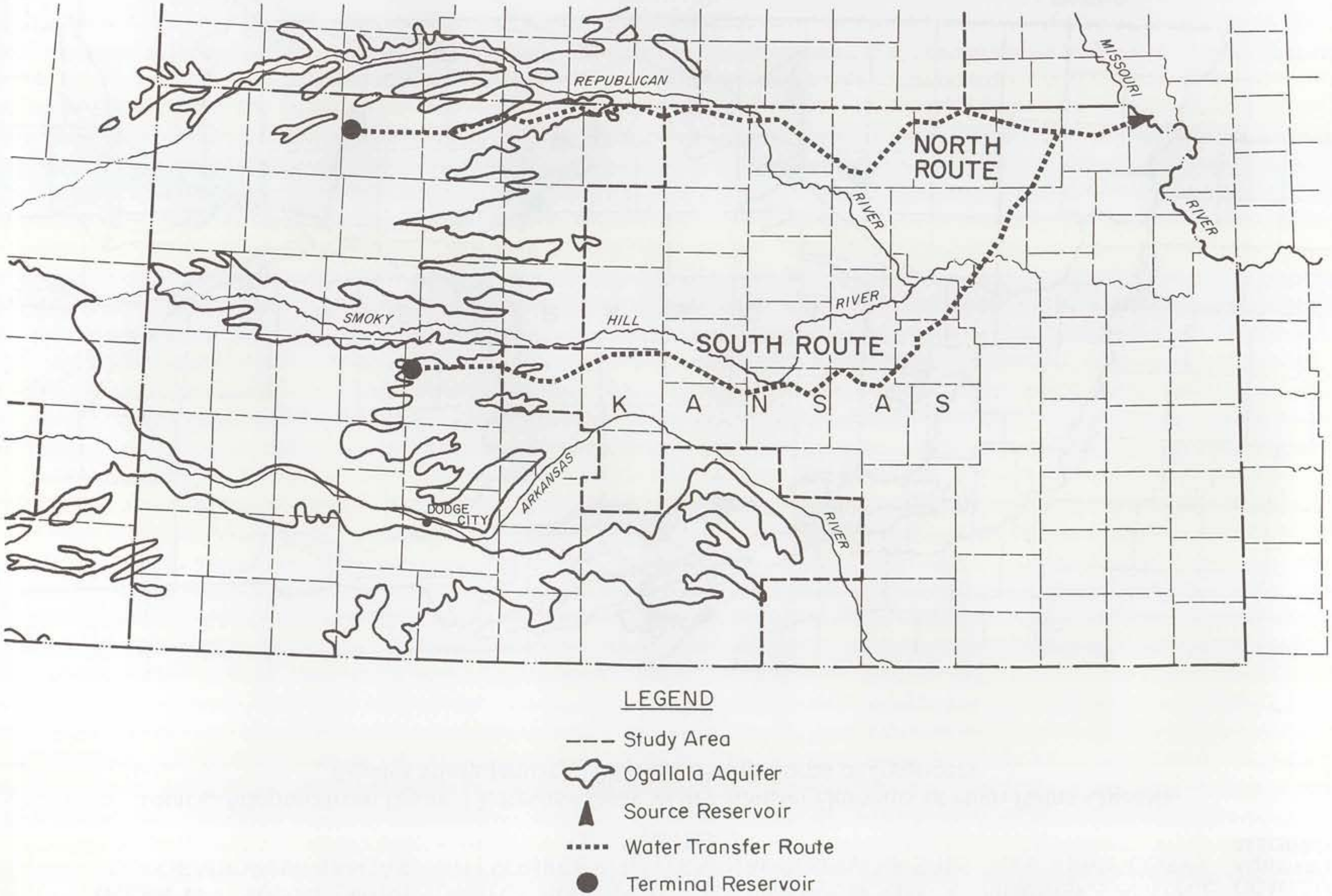


FIGURE VI-9: MANAGEMENT STRATEGY FIVE (MS-5)—ALTERNATIVE ROUTE "C", OKLAHOMA, TEXAS AND NEW MEXICO, WITH SOURCE AND TERMINAL RESERVOIR SITES—U.S. ARMY CORPS OF ENGINEERS

Source: Adapted from Figure 15, Review Draft, Water Transfer Elements of High Plains-Ogallala Aquifer Study, January 1982, U.S. Army Corps of Engineers

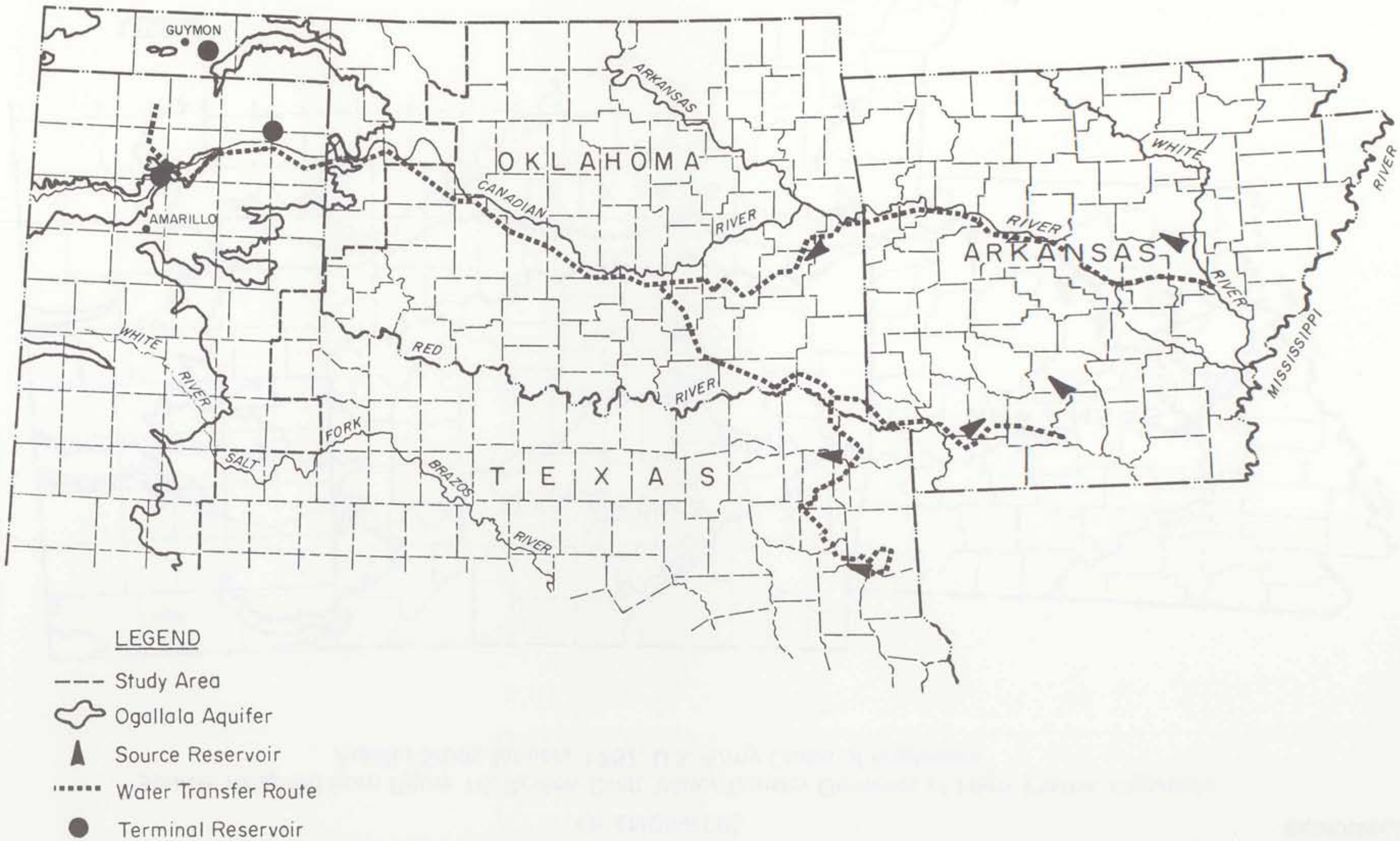


FIGURE VI-10: MANAGEMENT STRATEGY FIVE (MS-5)—ALTERNATIVE ROUTE "D", TEXAS AND NEW MEXICO, WITH SOURCE AND TERMINAL RESERVOIR SITES—U.S. ARMY CORPS OF ENGINEERS

Source: Adapted from Figure 16, Review Draft, Water Transfer Elements of High Plains-Ogallala Aquifer Study, January 1982, U.S. Army Corps of Engineers

For each route, the Corps made analyses for ranges of base flows to be released past the point of diversion, diversion pumping capacities, and conservation storage capacities to determine possible yields. The complexity of these interrelationships are illustrated by Figure VI-6, also excerpted from the Corps' Final Report.

Base Flow Allowances and Upstream Depletions

Under the assumptions made by the Corps as to base flows, diversion would be permitted only when the stream flow exceeded flows on the following table:

Table VI-50: MANAGEMENT STRATEGY FIVE (MS-5) - ASSUMED BASE FLOWS FOR ALTERNATIVE TRANSFER ROUTES (cubic feet per second)

Route		Average Annual Flow	Base Flow
A	Missouri River at Ft. Randall, SD*	-	31,000 (8 mo.)** 15,000 (4 mo.)**
B	Missouri River Near St. Joseph, MO*	-	41,000 (8 mo.)** 15,000 (4 mo.)**
C	White River at Clarendon, AR	29,200	5,000/20,000***
	Arkansas River at Van Buren, AR	30,150	10,000/20,000***
	Ouachita River at Camden, AR	7,600	3,000/10,000***
	Red River at Fulton, AR	17,400	5,000/20,000***
	Sabine River at Tatum, TX	2,300	1,000
	Sulphur River at Darden, TX	2,500	1,000
D	White River at Clarendon, AR	29,200	5,000
	Arkansas River at Pine Bluff, AR	30,150	10,000
	Ouachita River at Camden, AR	7,600	3,000
	Red River at Fulton, AR	17,400	5,000
	Sabine River at Tatum, TX	2,300	1,000
	Sulphur River at Darden, TX	2,500	1,000

* As regulated by upstream mainstem reservoirs.

** Navigation releases

*** Range considered

Source: Adapted from U.S. Corps of Engineers' Final Report.

For Routes A and B, the base flows are those necessary under present reservoir operating rules to maintain downstream navigation. The estimates of future upstream depletions made by the U.S. Bureau of Reclamation were used.

The base flow allowances for Routes C and D, include for convenience in the hydrologic analyses, adjustments for future upstream depletions as well as allowances for downstream needs.

Range of Transfer Quantities Evaluated

The Corps estimated the costs for each route for the following range of transfer quantities:

Route	Range* (million acre-feet per year)
A	1.908 - 3.404
B	1.615 - 3.404
C	1.260 - 7.510
D	1.550 - 8.680

* Delivered to farm head gate; allowance made for conveyance losses and reservoir evaporation.

For Route A, the minimum quantity would be sufficient to restore and maintain all of the irrigated lands in Nebraska plus one-half of those in Colorado that would go out of irrigation before 2020 under Management Strategy One. The maximum quantity would be sufficient to restore and maintain such lands in Nebraska, Colorado, Kansas, Oklahoma and the northern one-third of those in Texas. However, the Corps concluded that no water could be diverted form the Missouri River at Fort Randall without substantial impairment of navigation and hydrogeneration.

The minimum quantity for Route B would be sufficient to restore and maintain the irrigated lands in Kansas combined with all the needs for Colorado or Oklahoma. The maximum would suffice to restore and maintain currently irrigated lands that would revert to dryland farming by 2020 in Colorado, Kansas, Nebraska, Oklahoma and the northern one-third of those in Texas. The Corps' studies show that a maximum of 2.1 million acre-feet per year might be available for diversion from Missouri River near St. Joseph, Missouri, above in-basin needs within the constraints set forth in High Plains Study Council Resolution No. 6.

Routes C and D through Oklahoma and Texas were planned to deliver a range of amounts with the minimum set by the quantities necessary to restore and maintain irrigated lands in Texas, Oklahoma and New Mexico, and the maximum by the quantities that might be available for diversion above assumed base flow requirements of the sources as shown in Table VI-51.

The range of transfer quantities given for the several routes does not in any way imply that those quantities would actually be available for transfer.

Physical Details of Route Facilities

Relevant data concerning the four routes are presented in Table VI-52.

Environmental Assessment

The following material has been excerpted from the Corps' Final Report:

Route A (Nebraska)

The loss of aquatic habitat in Lake Francis Case and below Ft. Randall Dam on the Missouri River and the loss of woodland habitat due to the construction of Eagle Creek Reservoir; and wetland, woodland and native prairie losses due to canal construction in the Niobrara Valley and sandhills appear to be the most damaging fish and wildlife impacts on this route. These impacts are generally focused in the northern half of the study area.

Conversely the greatest fish and wildlife benefits occur in the southern half of the route. Assuming that woodland losses are adequately compensated

Table VI-51: BASE FLOWS ASSUMED FOR DIVERSION LIMITATIONS

SOURCE	AVERAGE ANNUAL FLOW (cfs)	ASSUMED BASE FLOW (cfs)
Sulphur River at Darden, Texas	2,500	1,000
Sabine River at Tatum, Texas	2,300	1,000
Arkansas River at Pine Bluff, Arkansas	41,500	10,000
Arkansas River at Van Buren, Arkansas	30,150	10,000
Ouachita River at Camden, Arkansas	7,600	3,000
Red River at Fulton, Arkansas	17,400	5,000
White River at Clarendon, Arkansas	29,200	5,000

Table VI-52: MANAGEMENT STRATEGY FIVE (MS-5) - ALTERNATIVE ROUTE TECHNICAL DATA

ROUTE	QUANTITY OF WATER DELIVERED (mafa)	LENGTH OF LINED CANAL (miles)	NO. OF INVERTED SIPHONS	LENGTH OF SIPHONS (miles)	ELEVATION DIFFERENCE START TO END (feet)	NO. OF PUMPING PLANTS/POWER GENERATING PLANTS	LENGTH OF PUMPING PLANT DISCHARGE CONDUIT (miles)	TOTAL LENGTH OF ROUTE (miles)
A	2.100	777[1]	15[2]	27.9[3]	2,401	18/0[4]	8.1[5]	813.0[6]
	4.160	777[1]	15[2]	27.9[3]	2,401	18/0[4]	8.1[5]	813.0[6]
B (North)	1.615	294	5	42.9	1,965	29/3	-[7]	336.9
	3.878	194	5	42.9	1,965	29/3	-[7]	336.9
B (South)	1.615	359	1	16.5	1,745	16/1	-[7]	375.5
	3.878	359	1	16.5	1,745	16/1	-[7]	375.5
C	1.260	577.1	-	7.8	3,281	26/0	25.2	610.1
	7.510	1,066.6[8]	-	19.5	3,618[9]	46/0	75.5	1,161.6[8]
D	1.548	565	1	2.0	2,610	21/0	-[7]	567.0
	9.680	845	3	6.3	2,725	30/0	-[7]	851.3

1 Includes 190.0 miles of side canals.
2 Includes 4 siphons on side canals.
3 Includes 3 miles of siphon on side canals
4 Includes 1 pumping plant on side canal.
5 Includes 0.1 mil on side canal
6 Includes 193.1 miles of side canal.
7 Included in the length of siphon.
8 Does not include 209 miles of Arkansas R. Navigation channel.
9 Maximum elevation difference (uses southern leg).

SOURCE: Adapted from U.S. Corps of Engineers' Final Report.

for, new reservoirs would provide increased public fishing and hunting opportunities, and flow increases in the North Platte and Platte Rivers as well as other streams in Nebraska and eastern Colorado. Construction of open water could help distribute crowded waterfowl populations over a larger area, thus reducing disease problems during spring migration.

Threatened and endangered species losses will probably be insignificant, adversely affecting only those aquatic species associated with the Missouri River. The black footed ferret is the only endangered species with a potential to be affected by the construction of the canal and reservoirs. It is possible that the whooping crane, the bald eagle and the interior least tern could benefit from certain aspects of the project.

Other impacts could be expected from the withdrawal scheme from both reservoirs and the Missouri River. Some of those impacts would include impingement/entrainment of aquatic organisms; effects on game fish spawning by exposing submerged vegetation, rock rip rap and other spawning habitat as a result of increased water level fluctuations; reduction of the littoral zone due to water drawdowns; less frequent flushing of the stagnant oxbows; and other riparian wetlands and increased vegetation encroachment on sandbars utilized by migratory waterfowl.

The canal route, if properly maintained, would offer several opportunities for enhanced habitat through improved quality nesting habitat and winter cover for a variety of ground nesting birds and other wildlife adapted to prairie conditions. Reservoirs could provide opportunities for fishing, waterfowl and upland game hunting, and nonconsumptive wildlife recreation.

Route B (Kansas)

Significant environmental impacts could be expected from the loss of 19,000 acres for the construction and operation of an intake storage facility and between 15,800 and 33,000 ares of habitat for terminal storage reservoirs for this route. This acreage does not include the conveyance facilities.

The intake structure storage facility would inundate an area containing scenic high loess bluffs and heavily dissected drainage valleys mantled with an oak-hickory forest containing significant terrestrial wildlife habitat. The inundation of the terminal storage site in western Kansas would have a major negative impact on terrestrial habitat such as white tailed deer. Some of these negative impacts could be ameliorated by the development and management of wildlife areas adjacent to the lake shore.

Both the southern route (376 miles) and the northern route (337 miles) would have an adverse impact on some mammals; the fenced canal creating a barrier along the entire length. Random movements of furbearers (coyotes, raccoon), small game (rabbit and squirrel) and big game (mule and white tailed deer) would be restricted. The construction of the canal would remove between 26,300 and 37,600 acres of private land from agriculture production on the southern route and 23,600 and 33,700 acres along the northern route.

There are no known federal endangered species, major wetlands, or listed archeological and historic sites that would be disturbed along either route. The state lists the Topeka shiner, and the blue sucker which might be affected by construction of such a project.

Several unique or sensitive areas have been identified along the potential routes which would require special consideration and study. The Flint Hills Prairie is a 30-mile wide band of native grassland which extends along a north-south line in the eastern part of Kansas. It is of special significance and its geologic preservation is important.

Large refuges, management areas, and preserves could be affected by channel alignment.

Sink holes which are underlain by easily dissolved salt or gypsum could adversely impact the channels. Earthquakes have been reported and the possibility for others exists.

Route C (Oklahoma)

The construction of more than 1,000 miles of canal and the inundation of more than 300,000 acres of land by storage reservoirs to put this transfer into place would have major and permanent environmental impacts.

Each of the seven reservoirs associated with the project would have environmental, social and cultural resources impacts equivalent to a large multipurpose project. The beneficial gains normally associated (lake, fisheries, recreation, etc.) with most water resource projects, due to the widely fluctuating water levels which must be a part of this route plan, would not be dependable.

Numerous threatened and endangered mammals, fish, birds, reptiles and invertebrates would be adversely affected. Further, some 31 wetland areas would be affected as would at least five important wildlife habitat areas in Arkansas, Oklahoma and Texas.

The impacts of transporting a softer more acidic water into the hard water of Lake Meredith should be looked at in greater detail. More study into the impact of the transportation of water and microscopic organisms from different drainage basins into the area would be needed.

Finally the diversion of water would most likely have direct and secondary repercussions downstream as far as the coastal area. More intensive coastal fisheries and habitat studies would be necessary.

Route D (Texas)

Like Route C, this route would involve long concrete lined canals (900 miles) and large reservoir storage areas (437,000 acres) which would generally have long-term permanent impacts like those mentioned for Route C.

Rare and endangered species which could be affected include the bald eagle and the peregrine falcon and possibly the whooping crane during the spring and fall migration. The American alligator and the red cockaded woodpecker are also found along the corridor; both are listed species. There are other species which might be impacted to a lesser degree. Further information may be found in the Fish and Wildlife report.

There are methods available to reduce and minimize the adverse impacts on fish and wildlife resources through facility design and detailed mitigation planning. Wildlife mitigation costs were included in the overall cost estimates.

Wetlands and bottomland hardwoods in southwestern Arkansas and wildlife habitat in northeast Texas would be lost or modified along the route.

Several sites listed in the National Register of Historic Places or listed as eligible to be listed are along the corridor. Only twelve should be affected and eleven of these twelve could conceivably be avoided or protected from direct impact. Only the Jenkins Ferry Battlefield would be directly affected as it lies within the maximum limit of a proposed reservoir on the Sabine River.

Because of various factors the aesthetic and recreational potential along most of the route are very limited. The terminal storage site at Blanco Canyon, however, could prove to be a valuable recreational site.

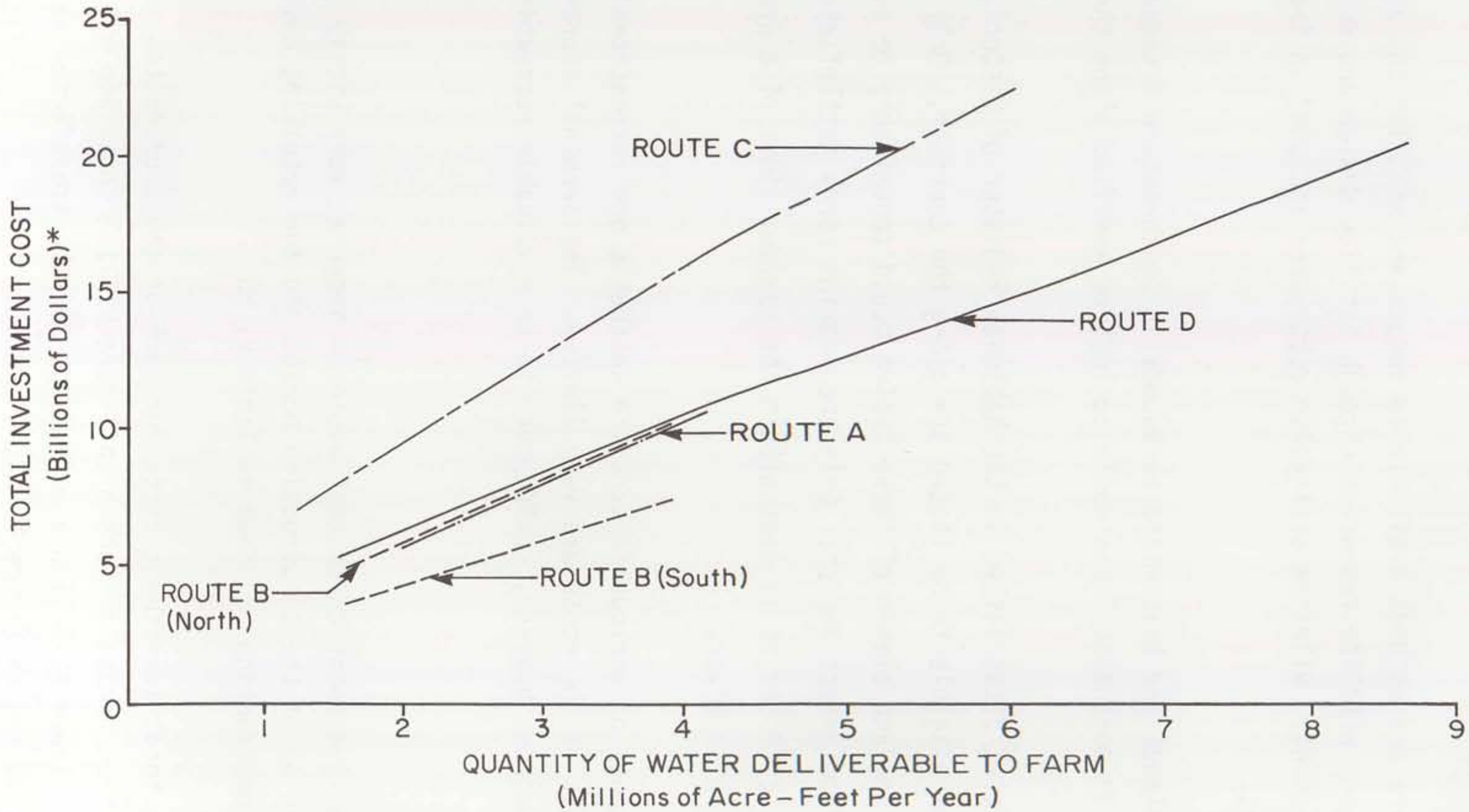
Costs

The investment costs that would be incurred vary widely depending upon the duration of the construction period and the resulting costs for interest during construction as shown in Table VI-53.

The total investment costs for each of the four routes for a 15-year construction period are shown on Figure VI-11. Total annual costs are presented in Table VI-54 whole unit costs for the transferred water are shown in Table VI-55 and on Figure VI-12.

FIGURE VI-11: MANAGEMENT STRATEGY FIVE (MS-5)—COMPARATIVE TOTAL COST CURVES, ALTERNATIVE WATER TRANSFER ROUTES—U.S. ARMY CORPS OF ENGINEERS

Source: Adapted from Figure 17, Review Draft, Water Transfer Elements of High Plains-Ogallala Aquifer Study, January 1982, U.S. Army Corps of Engineers



* Cost does not include cost of distribution of imported water from terminal reservoirs to farm headgates.

FIGURE VI-12: MANAGEMENT STRATEGY FIVE (MS-5)—COMPARATIVE UNIT WATER COST CURVES, ALTERNATIVE WATER TRANSFER ROUTES—U.S. ARMY CORPS OF ENGINEERS

Source: Adapted from Final Report, Water Transfer Elements of High Plains—Ogallala Aquifer Study, January 1983, U.S. Army Corps of Engineers

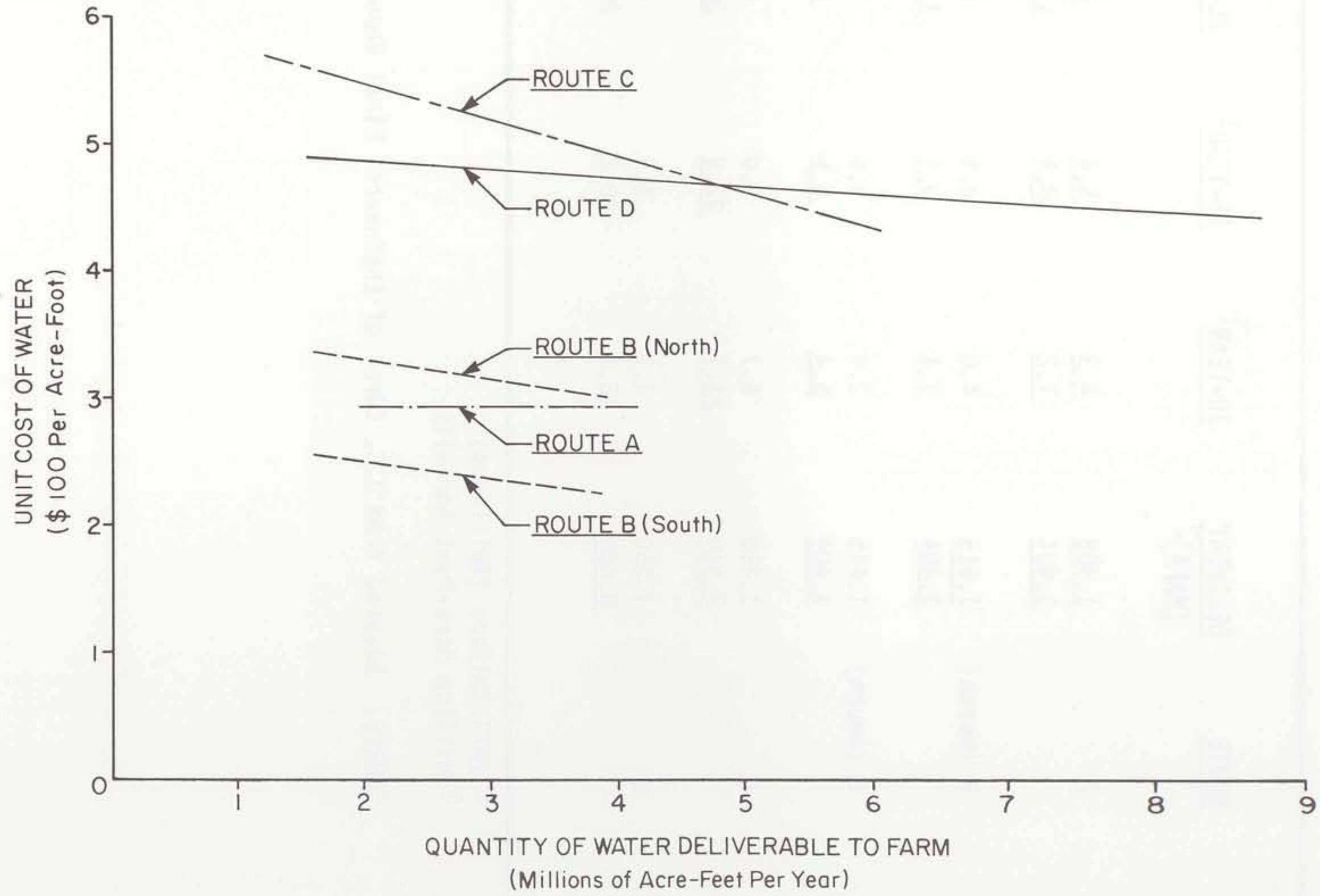


Table VI-53: MANAGEMENT STRATEGY FIVE (MS-5) - TOTAL INVESTMENT COST FOR INDICATED CONSTRUCTION PERIOD[1]

ROUTE	DELIVERY (MAFA)[2]	10-YEAR[1]	15-YEAR[1]	20-YEAR[1]
A	1.908	4.3	5.4	6.7
	3.404	7.2	8.9	11.0
B (North)	1.615	4.0	4.9	6.0
	3.404	7.4	9.1	11.2
B (South)	1.615	2.9	3.6	4.4
	3.404	5.4	6.5	8.1
C	1.260	5.7	7.0	8.6
	7.510	22.7	27.8	34.4
D	1.550	4.7	5.3	6.5
	8.680	16.2	20.6	26.2

[1] 1977 Dollars ($Billions)

[2] Million Acre-Feet Annually

SOURCE: Adapted from U.S. Corps of Engineers' Final Report.

Table VI-54: MANAGEMENT STRATEGY FIVE (MS-5) - TOTAL ANNUAL COSTS FOR ALTERNATIVE TRANSFER ROUTES (billion $)

ROUTE	QUANTITY TRANSFERRED[3]	INTEREST AND AMORTIZATION[1]	OPERATION/MAINTENANCE AND REPLACEMENT	ENERGY[2]	TOTAL
A	1.908	0.396	0.010	0.150	0.556
	3.404	0.654	0.012	0.324	0.990
B (North)	1.615	0.357	0.008	0.175	0.540
	3.404	0.668	0.012	0.354	1.034
B (South)	1.615	0.263	0.008	0.142	0.413
	3.404	0.481	0.011	0.281	0.773
C	1.260	0.513	0.010	0.194	0.717
	7.510	2.050	0.030	1.150	3.230
D	1.550	0.576	0.010	0.174	0.760
	8.680	2.680	0.022	1.134	3.836

[1] 7-3/8% interest. 100-year-period of analysis, 15-year construction period.

[2] 1981 energy price in 1977 dollars.

[3] Million acre-feet annually.

SOURCE: Adapted from U.S. Corps of Engineers' Final Report.

Table VI-55: MANAGEMENT STRATEGY FIVE (MS-5) - UNIT COSTS/ACRE-FOOT FOR ALTERNATIVE TRANSFER ROUTES[1]

ROUTE	QUANTITY TRANSFERRED (MAFA)[3]	ENERGY COST[2] $/Acre-Foot	UNIT COST OF WATER $/Acre-Foot
A	1.908	79	291
	3.404	95	291
B (North)	1.615	108	335
	3.404	104	304
B (South)	1.615	87	255
	3.404	82	227
C	1.260	154	569
	7.510	153	430
D	1.550	112	490
	8.680	130	441

1 15-year construction period, first cost amortized at 7-3/8% interest for 100-years, energy and construction costs in 1977 dollars.

2 Energy cost based on 1981 energy price in 1977 dollars.

3 Million Acre-Feet annually.

SOURCE: Adapted from U.S. Corps of Engineers' Final Report.

Conclusions and Findings

The following conclusions and findings are quoted directly from the Corps' Final report:

"1. Construction of canal systems capable of transporting up to nine million acre-feet of water from adjacent areas is feasible from an engineering standpoint.

2. The first cost of such systems ranges from $3.6 billion for a system to deliver 1.6 million acre-feet per year to western Kansas to $27.8 billion to deliver 7.5 million acre-feet per year to the northern panhandle of Texas and the panhandle of Oklahoma. The costs are in 1977 dollars and the construction period is assumed to be 15 years.

3. The annual cost for such systems ranges from $413 million per year for the Kansas route to $3.8 billion per year to transfer 8.7 million acre-feet to near Lubbock, Texas along Route D. Those annual costs include energy at current prices in 1977 dollars.

4. The costs in this report do not include a distribution system beyond the terminal reservoirs. The quantities of water have been reduced by a factor of 10% to account for losses in distribution.

5. The unit cost of water delivered to terminal storage in the High Plains-Ogallala area ranges from $227 per acre foot to $569 per acre-foot in 1977 dollars.

6. The construction of any of these systems would require from 10 to 20 years with 15 years considered a reasonable period. Reducing or increasing the construction period by 5 years can alter the investment cost by as much as 25%.

7. Massive amounts of energy would be required to operate any of the systems. From 4 to nearly 50 billion kilowatt hours per year of electrical energy would be required to operate any one system. The annual cost of that energy in 1977 dollars would range from $140 million to $1.1 billion.

8. If increases in energy cost occur as projected the unit cost of water will range from $320 to $880 per acre-foot in year 2105.

9. Water sources exist in areas adjacent to the High Plains with sufficient flow to provide up to 8.7 million acre-feet per year of water for transfer to the High Plains. None of that water has been identified as surplus to the needs of the basin of origin.

10. Construction of any of the routes would result in major environmental impacts. These impacts would include altered flow

regime on the source streams, inundation of large areas for source and terminal storage, conversion of large amounts of agricultural land to other purposes, disruption of wildlife patterns and transfer of organisms to near areas. Any future studies considering implementation should include comprehensive environmental studies."

Findings:

1. The U.S. Army Corps of Engineers makes no recommendation regarding further consideration of any of the water transfer routes. This position is consistent with the directions of the High Plains Study Council for the Corps to determine only the costs and impacts of the various alternative routes.

2. We find that the transfer routes themselves are engineering feasible.

3. We find that there are water sources in the areas adjacent to the High Plains that could physically supply sufficient water to restore and maintain the irrigated lands that are projected to revert to non-irrigated status by year 2020. We have not determined that such water is surplus to the present and future needs of the source basin.

4. We find that significant environmental impacts will result from construction of the transfer routes with the bulk of the readily identifiable adverse impacts resulting from reservoir construction.

5. We find that much more detailed study is necessary to firmly define the costs and impacts associated with any of the routes but the policy questions of priority, pricing, and economic feasibility should be resolved first."

The Corps' Final Report also notes the following potential related opportunities which were not evaluated.

"This reconnaissance level study only considers costs to transfer water from specific sources to specific terminal points. However, opportunities exist throughout the system to develop related benefits which could help justify the systems costs. For example, flood control could be included in conjunction with the source and terminal reservoirs and recreation and fish and wildlife benefits could be considered at the reservoirs and along the canals themselves. In addition, municipal and industrial water supply as well as supplemental wildlife water supplies are very probable multipurpose opportunities along the transfer routes. Although it was evident that additional project related opportunities existed with each of the transfer plans evaluated, an in-depth study of them was considered to be beyond the scope of this reconnaissance level planning effort."

The possibility also would exist of combining and integrating Routes A and C with the intrastate transfer schemes for Nebraska and Oklahoma, respectively, described under Management Strategy Four above.

Distribution Costs

As part of its studies for the Oklahoma Comprehensive Water Plan, the U.S. Bureau of Reclamation estimated the capital costs of distribution from terminal reservoirs to farm headgates as $2,150 per acre (1978 dollars). USBR estimates were based on analyses of costs for four case studies. The General Contractor considers these costs as appropriate for use in this Study. Operation and maintenance costs for distribution would vary widely throughout the Region, in part due to the amount of pumping required.

Impacts of the diversions and transfer of water to the High Plains are presented in the following discussion.*

MANAGEMENT STRATEGY FIVE-A - AGRICULTURAL SECTOR

Water Availability Impacts

(Figures VI-17 and 18, this section)
(Table VI-22, Appendix B)

Strategy Five-A brings 4.1 million acre-feet of imported water to the High Plains. This import permits the largest amount of total irrigation water use, up to 25.4 million acre-feet in 2020, 21.0 percent above the Baseline and 19.0 percent above Strategy One. The largest amounts of imported water would go to Nebraska and Kansas (66 percent of the total import in 2020; 13.0 percent to Texas; the remaining 21.0 percent going to the other three states). Because pumping continues at Strategy One rates (for MS-5A) and Strategy Two rates (for MS-5B) where ground water remains, these strategies produce no change in the amount of water left in storage.

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* Emphasis is on MS-5A results because they are generally more favorable than MS-5B.

Land in Production (Irrigation/Dryland)

(Figures VI-19 and 20, this section)
(Tables VI-23 and 23.1, Appendix B)

The 4.1 million acre-feet of water imported in Strategy Five-A permits total irrigated acreage in the Region to rise to 23.6 million acres in 2020, an increase of 24.0 percent over irrigated acreage in Strategy One. All states show a rise in irrigated acreage with the availability of imported water. Nebraska has the largest absolute increase in irrigated acres (over 2,000,000 when Strategy Five-A is compared with Strategy One in 2020). Total irrigated acreage in the Region was projected to increase by over 5.5 million acres for Strategy Five-A in comparison to Baseline projections for 2020. Dryland acreage in the Region was projected to decrease 3.54 million acres in 2020 compared to Baseline, with a net increase of 2.01 million acres (5.3 percent) in total irrigated and dryland crop acreage for the Region by 2020.

Production - Six Significant Crops

(Figures VI-21 through VI-26, this section)
(Tables VI-24 and 24.1, Appendix B)

Imported water significantly increases production of irrigated crops. Corn shows the greatest increase (22.4 percent) over Baseline in 2020. The percentage increase in corn production is projected to be greatest in Kansas, and least in Nebraska. Sorghum production falls 6.0 percent in 2020 for the Region but production of soybeans is projected to increase 11.0 percent over Baseline, as does alfalfa. Cotton production is projected to use much of the available import water supply in Texas. A 19.5 percent increase in cotton production is projected for the entire Region by 2020 in comparison to Baseline projections. Wheat, the dominant dryland production crop, shows a production decrease of 7.5 percent below Baseline in 2020.

Value of Agricultural Production

(Figure VI-27, this section)
(Tables VI-25, Appendix B)

Total value of agricultural production after price adjustments to reflect increased production was projected to increase by over $1.7 billion in 2020 due to Strategy Five-A (a 15.0 percent increase over Baseline) with 75 percent of that increase in the northern three states. With water import, production of crops requiring irrigation expand significantly and reduction in dryland crops (particularly wheat), occur as land is returned to irrigation. For the Region as a whole, Strategy Five-A gives an increase of approximately $1.3 billion over Strategy One. Nebraska receives the largest total increase in value of production as a result of water imports.

Returns to Land & Management and Imported Water

(Figure VI-28, this section)
(Table VI-26, Appendix B)

Returns to land and management would be up in each state; the values include the returns to imported water. Increases in returns when Strategy Five-A is compared with Strategy One in 2020 vary from over 33.0 percent in New Mexico to approximately 9.0 percent in Nebraska and 11.0 percent in Texas. For the Region, returns to land and management increased $730 million or 15.0 percent over Baseline in 2020. It is important to note that the estimations of returns to land and management under this strategy do not impose a charge for imported water. If irrigators were charged at the estimated ability to pay for imported water total returns to land management and water for Strategy Five-A would be less than for Baseline.

MANAGEMENT STRATEGY FIVE-A - REGIONAL ECONOMIC IMPACTS

Because Management Strategy Five-A permits application of water at higher Strategy One levels, agricultural production and all the linked economic variables are higher in Strategy Five-A than in Strategy Five-B, which limits continuing application of ground water to Strategy Two (restricted) levels. The results for total value added, employment, total household income and state and local government tax revenues are calculated for both levels of Strategy Five. The results presented exclude charges associated with water importation; the results shown here pay nothing for imported water. They show the gross benefit from water imports prior to the collection of water charges or local taxes to repay allocated costs of constructing and maintaining import facilities. The economic feasibility of imports to the High Plains would have to be determined through detailed analyses not included in this Study, and would apply the project analysis and cost allocation procedures required at that time.

Regional Value Added

(Figures VI-29 and 30, this section)
(Tables VI-27 and 28, Appendix B)

Total value added in the regional economy is up by almost \$1.0 billion (2.2 percent) when compared to the Baseline in 2000. By 2020, the net gain for the regional economy rises to almost \$2 billion (4.1 percent). When compared with Strategy One, the gains from water importation are somewhat smaller - \$633 million (1.4 percent) in 2000, and \$1.5 million (3.1 percent) by 2020.

When the results are broken down by North and South subregions, both portions of the High Plains show substantial economic gains. However, the northern subregion shows larger gains. In the North in 2020, total value added in the Region increases by \$1.53 billion, while the economy in the South expands only by \$471 million.

Bringing imported water to the High Plains Region in the later years of the study (2000 and 2020) strengthens the regional economy but also makes it more dependent on agricultural production. In 2020, the northern Ogallala area is 37.5 percent dependent on farm production alone as measured by value added, without consideration of the linked industries. This is up from 34.8 percent dependence in the Baseline and 35.7 percent in Strategy One. In the South in 2020, imported water boosts farm production to 7.6 percent of the economy, up from 6.7 percent in the Baseline.

Employment and Household Income

(Figures VI-31 and 32, this section)
(Tables VI-29 and 29.1, Appendix B)

Imported supplies of surface water would produce additional jobs in the Region. Employment in the Region is projected to increase by 63,000 jobs in 2020 when compared with the Baseline, and 49,000 when compared with Stragegy One. Of particular significance is that the employment increase associated with imported water is sufficient to nearly halt the loss in jobs, otherwise expected to occur in the southern Ogallala area as energy resources are depleted. In the Baseline, total employment in the South is expected to fall from 795,000 in 2000 to 778,000 in 2020. With the addition of imported water supplies, employment in the South increases to 803,800 in 2000 but falls to 793,000 in 2020. In the northern Ogallala, where employment increases gradually under Baseline conditions, the availability of imported water results in a 13 percent jump in employment between 1990 and 2020, compared to the 4.0 percent increase which would have occurred in the Baseline. Total payments to households by 2020 increase by $1.3 billion in comparison to Baseline projections with about a 2 to 1 advantage for the northern subregions. Again, these figures reflect no contribution towards the cost of the import scheme; such payment by local farmers or businessmen would reduce payments to households.

Population

(Figure VI-33, this section)
(Table VI-30, Appendix B)

Expanded employment means that a larger population can be supported in the Region with the same rates of unemployment and labor force participation. Population for the entire Region would be 134,000 larger than would be expected in the Baseline in 2020; 106,000 larger than under Strategy One. The increase in employment in the South would moderate the decline in population between 2000 and 2020 which would otherwise occur.

Per Capita Income

(Figure VI-34, this section)
(Table VI-31, Appendix B)

Due to changes in household income and population, per capita income shows a small (0.9 percent) decline for the Region by 2020, with most of the decrease in the northern subregion. This decrease does not allow for payments for imported water which may reduce per capita income.

Payments to State and Local Governments

(Figure VI-35, this section)
(Table VI-32, Appendix B)

With existing tax structures, additional income is still insufficient to maintain state and local government revenues in the Region. Revenue is up by $58 million (4.2 percent) over the Baseline, and $43 million (3.1 percent) over Strategy One in 2020. However, total state and local government revenues are $65 million below 1990 Baseline levels. The increased economic gain from irrigation increases the rate of growth of revenue in the North. In the South, this change would be insufficient to offset the loss of oil and gas tax revenues. Strategy Five-A adds $8 million to tax revenues in the South in 2020, but still falls $423 million below 1990 levels for Strategy One. Losses have not been adjusted to provide for any government levy to help offset the cost of the water import scheme.

MANAGEMENT STRATEGY FIVE - OTHER IMPACTS

Cost Estimates

Relevant cost estimates and projections for the periods 2000 and 2020 are provided in previous sections for the water transfer strategies. An exception is related to the increased irrigated acreage associated with the water importation strategies. This amounts to 4.6 million acres by 2020 under Strategy Five-A and would constitute a substantial increase in total costs for water management improvements over those entailed by Strategy One.

For water management improvements to the level of treatment projected for Strategy One, the additional 4.6 million acres maintained in irrigation by Strategy Five-A would represent an additional $90 million investment.

National Consumer Price and Export Market Effects

Exports of major agricultural commodities are projected to increase under Strategy Five. By 2020, with restored water, total grain exports would rise almost 100 million bushels, or about 0.8 percent from the Baseline. Cotton exports rise by 0.5 million bales, or around 4.4 percent. The total value of exports in 2020 actually declines for grains and oilseeds by approximately $100 million since farm prices fall more than exports increase. For the same reason, the value of cotton exports falls by approximately $30 million.

As with Strategy Two, the NIRAP model did not reflect changes in livestock prices resulting from rather small changes in feed grain prices (decrease of 0.1-1.7 percent for soybeans, sorghum, and corn). However, if it is assumed that a decrease in farm prices would be passed through entirely, then the major commodity impact of Strategy Five-A on consumer expenditures for food would be a decrease of about $2 per person or $564 million for the entire U.S. by 2020. This cost might decline $5.30 per person per year, or $1.3 billion for the U.S., if each of the intermediate handlers in the food system decreased their prices by the same percentage as grains, oilseeds, and cotton prices decreased at the farm sector. Consumers would increase consumption slightly because of the lower cost.

These estimates should be treated with care. While consumers may see a small advantage in food price, the direct commodity price reduction will be paralleled by a reduction in farm incomes nationwide. Where commodities are a small percentage of delivered food prices, and consumers will not even see the benefit of the price reductions which will reduce farm income. On a national basis, commodity price reductions produce a "zero sum" redistribution between farmers and consumers nationwide and cannot be named as a national benefit that could be contributed towards the cost of an import scheme.

Restoring irrigated acreage does increase the national supply of grains, oilseeds, and cotton over the Baseline. However, these gains are mixed: consumers benefit marginally in lower prices by $500-600 million annually but the value of exports declines by over $130 million. The U.S. is providing slightly more agricultural commodities to the world but at cheaper prices.

Under Strategy Five-B, when previously irrigated acreage lost under Strategy Two is restored to irrigation, agricultural production and prices virtually duplicate the Baseline. Thus, Strategy Five-B would not result in significant changes in consumer food expenditures or in the value of agricultural exports when compared to the Baseline.

Addition of imported water significantly increases the importance of the High Plains Region in national production of two crops. Corn production in the Region in 2020 would be up to 15.2 percent of the national total from 12.6 percent in the Baseline, and cotton rises to 37.2 percent of the national crop (2020) from 31.9 percent in the Baseline.

Ability to Pay for Water

The projections of returns to land, management and water for MS-5 reflect no payments for imported water. Water has been taken as free--which it will not be--in order to show the full increase in returns which the farmer might receive. In fact, farmers will be asked to pay some amount of this increased return towards the cost of water importation.

To determine the ability to pay for water, reseachers determined the difference between dryland and irrigated returns to land and management for each crop. To this was added the cost of pumping ground water in the Region. The resultant value, calculated on a per acre basis, gives the maximum amount that a farmer could pay for imported water. The actual amount that a farmer will pay for imported water is substantially less, as no farmer would surrender the "full value" of increased return.

This value was calculated on a per acre basis for all lands to which imported water would be supplied under Strategy Five. The results are shown in Figures VI-13 through VI-16 for 2000 and 2020. By picking any particular price on the Y axis, the curve will show the cumulative amount of water demanded if water is priced at or below the figure. Under Strategy Five-A in 2020, only 100,000 acre-feet could be sold at an ability to pay of $330 per acre-foot. For much of the Region, the maximum ability to pay is around $120 per acre-foot in this year. The lands which could pay the highest price for water are fertile cotton lands in the south plains, while ability to pay for water generally decreases to the north and east as dryland/irrigated differentials decrease. Overall, this factor is heavily influenced by the intrinsic fertility of a particular subregion.

The results shown in the Figures should be used with caution, as they actually overstate the amount that a farmer will pay for water. However, if the percentage of the maximum value shown on these charts which the farmer may be willing to pay is assumed, an effective water "price" can be derived as a rough measure of the possible farmer contribution towards repayment of the costs of an import scheme.

Institutional Implications

Each of the streams that have been considered by the U.S. Corps of Engineers as a potential source for an interstate, interbasin transfer to the High Plains Region is interstate in character. There is one or more existing or authorized federal projects on each; these projects have been authorized for specific purposes, generally some combination of irrigation, municipal and industrial uses in designated areas, flood control, hydropower generation, navigation, recreation and other instream uses. Diversion for interbasin transfer to the Region, if sufficiently large in amount, could impair existing and future downstream uses both instream and consumptive. Depletions by future uses upstream of the point of diversion would decrease over time the amount available for interbasin transfer to the Region. If existing or authorized uses might be impaired, or future upstream depletive uses limited, the tradeoffs involved would have to be carefully evaluated and possibly some form of compensation provided for at least some of the opportunity costs.

FIGURE VI-13: MANAGEMENT STRATEGY FIVE-A (MS-5A)—DEMAND FOR IMPORTED WATER IN YEAR 2000, SUBREGIONAL "ABILITY TO PAY" BASED UPON PROJECTED DIFFERENCES IN RETURNS TO DRYLAND AND IRRIGATED PRODUCTION AND COSTS OF PUMPING GROUND WATER PER ACRE

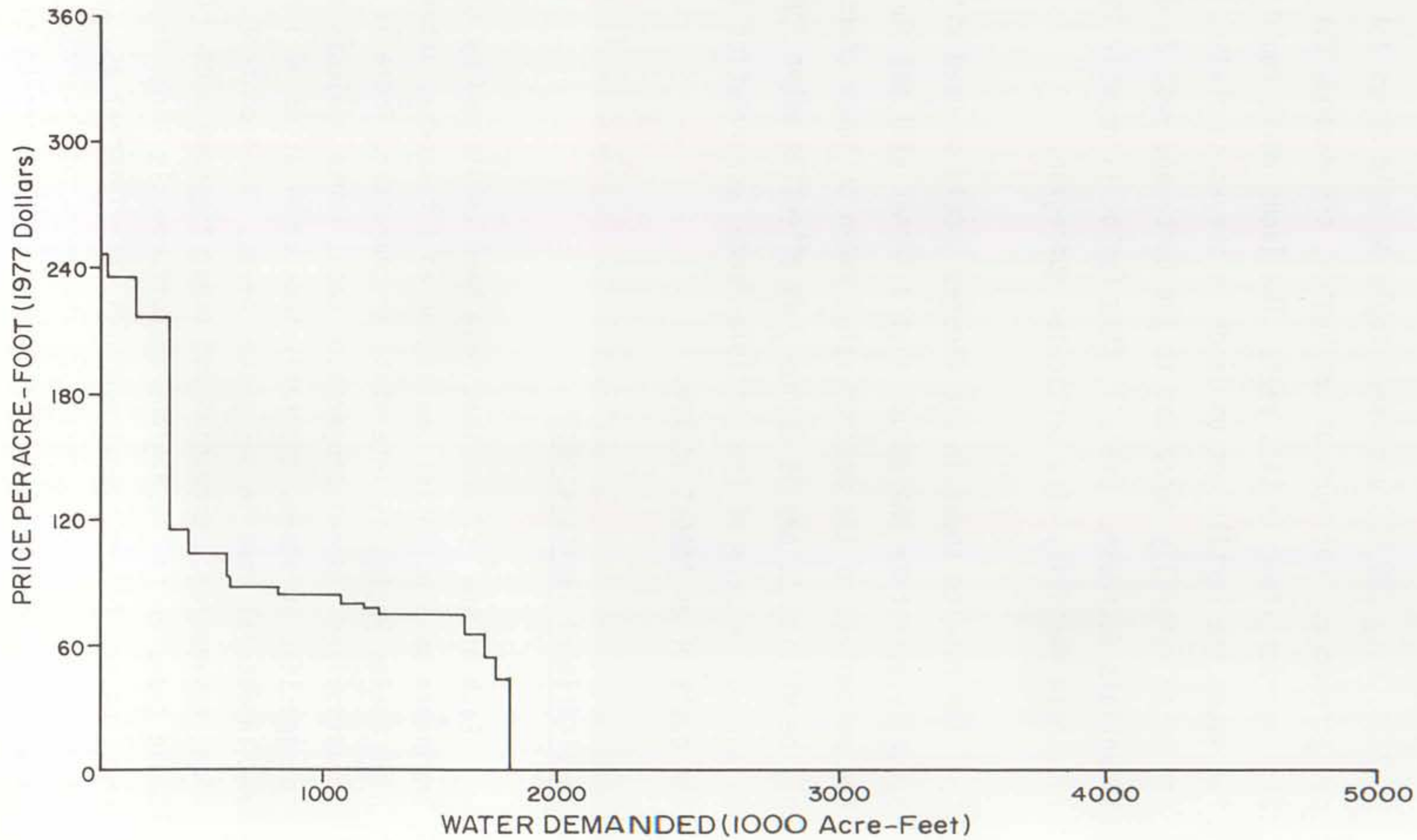


FIGURE VI-14: MANAGEMENT STRATEGY FIVE-A (MS-5A)—DEMAND FOR IMPORTED WATER IN YEAR 2020, SUBREGIONAL "ABILITY TO PAY" BASED UPON PROJECTED DIFFERENCES IN RETURNS TO DRYLAND AND IRRIGATED PRODUCTION AND COSTS OF PUMPING GROUND WATER PER ACRE

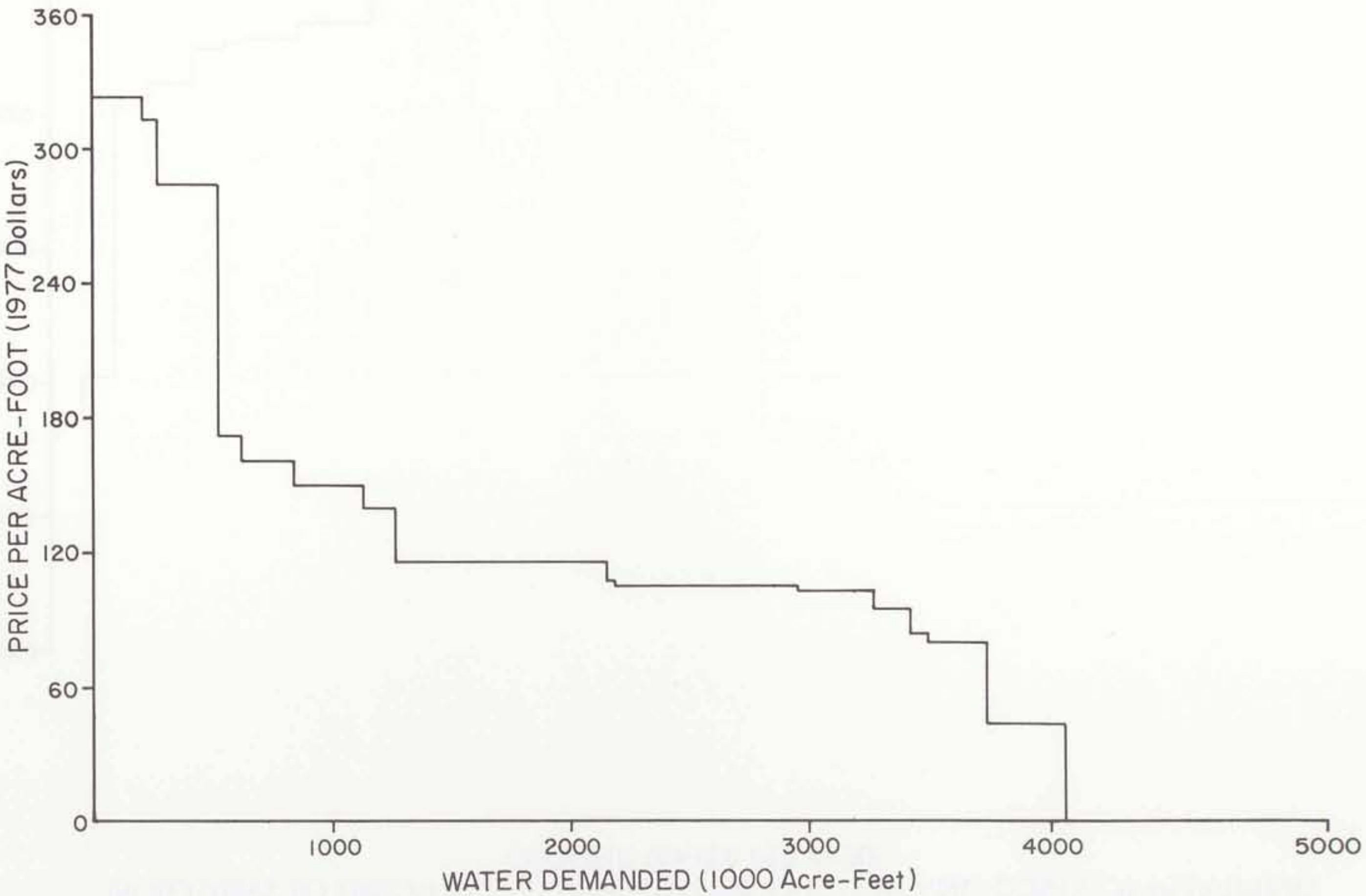


FIGURE VI-15: MANAGEMENT STRATEGY FIVE-B (MS-5B)—DEMAND FOR IMPORTED WATER IN YEAR 2000, SUBREGIONAL "ABILITY TO PAY" BASED UPON PROJECTED DIFFERENCES IN RETURNS TO DRYLAND AND IRRIGATED PRODUCTION AND COSTS OF PUMPING GROUND WATER PER ACRE

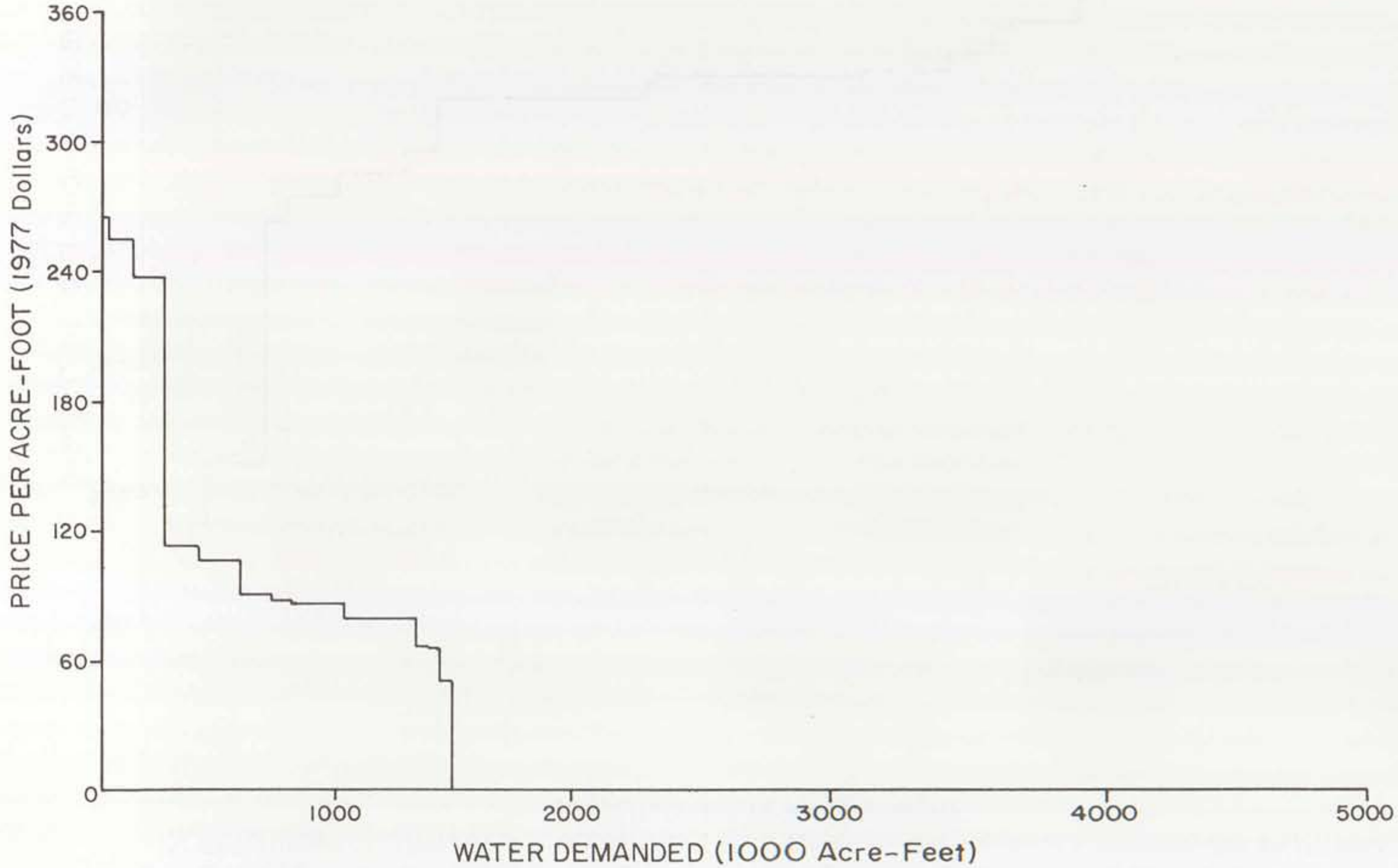
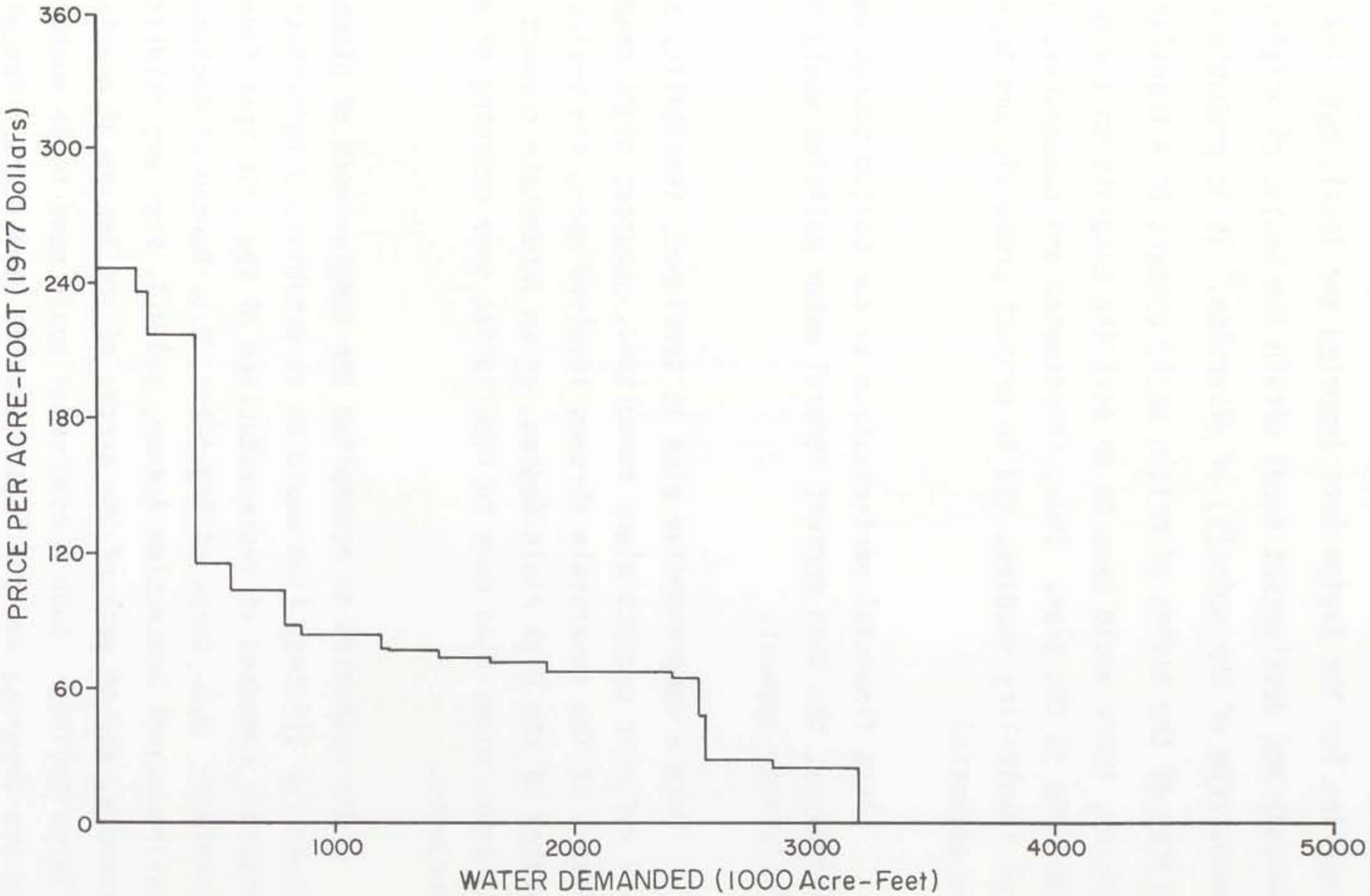


FIGURE VI-16: MANAGEMENT STRATEGY FIVE-B (MS-5B)—DEMAND FOR IMPORTED WATER IN YEAR 2020, SUBREGIONAL "ABILITY TO PAY" BASED UPON PROJECTED DIFFERENCES IN RETURNS TO DRYLAND AND IRRIGATED PRODUCTION AND COSTS OF PUMPING GROUND WATER PER ACRE



Before a specific interstate, interbasin transfer project for supply to the High Plains Region could be proposed for authorization and funding, a great deal of detailed planning and feasibility study must be accomplished. This would encompass not only the needs, development and management of water supplies for the Region both imported and local, but also the future water demands and development needs within the basins of origin, both upstream and downstream of the point(s) of diversion. It is probable that before the states of the basins of origin would consent to a transfer of water to the Region, there would have to be definite benefits to the basins of origin included in the plan. Thus, coordinated and cooperative effort in planning and feasibility studies, and in project proposals and implementation would be essential.

Since financial participation by the United States would undoubtedly be necessary, the then current federal water policies would have to be taken fully into account.

Once a comprehensive plan is developed, feasibility studies completed and definite project plans formulated, Congress might need to apportion the waters of the interstate streams involved among the basins of origin and the states of the High Plain Region, <u>or</u> an interstate compact consummated. Congress might also have to reauthorize some existing or authorized federal projects.

One mechanism to accomplish the complex work of planning and feasibility study for Strategy Five would be to establish a federal-state planning commission, composed of representatives of the principal federal agencies involved: U.S. Corps of Engineers, U.S. Bureau of Reclamation, U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service for example, and of each of the states of the basins of origin and the High Plains Region. Such a commission would need to be authorized and funded by the Congress and the legislature of each state. Actual planning and feasibility studies could be done by federal and state agencies, and/or by the private sector, under contract with the commission.

The commission could be transformed into the requisite overall management commission once a transfer project(s) was authorized. Extensive authorities and powers would be necessary.

Design, construction and operation and maintenance of the transfer facilities--diversion, conveyance, storage, and distribution works--would probably be the responsibility of the U.S. Corps of Engineers or U.S. Bureau of Reclamation or both, under the overall direction of the management commission.

Local agencies would be necessary in each state to receive and distribute the imported water in conjunction with local ground and surface supplies, operate and maintain local works, and collect taxes and/or water charges for payment of reimbursable costs. Texas has already authorized an import authority for West Texas but it has not actually been created yet.

FIGURE VI-17: ALTERNATIVE MANAGEMENT STRATEGIES ANNUAL WATER USE RATES, WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

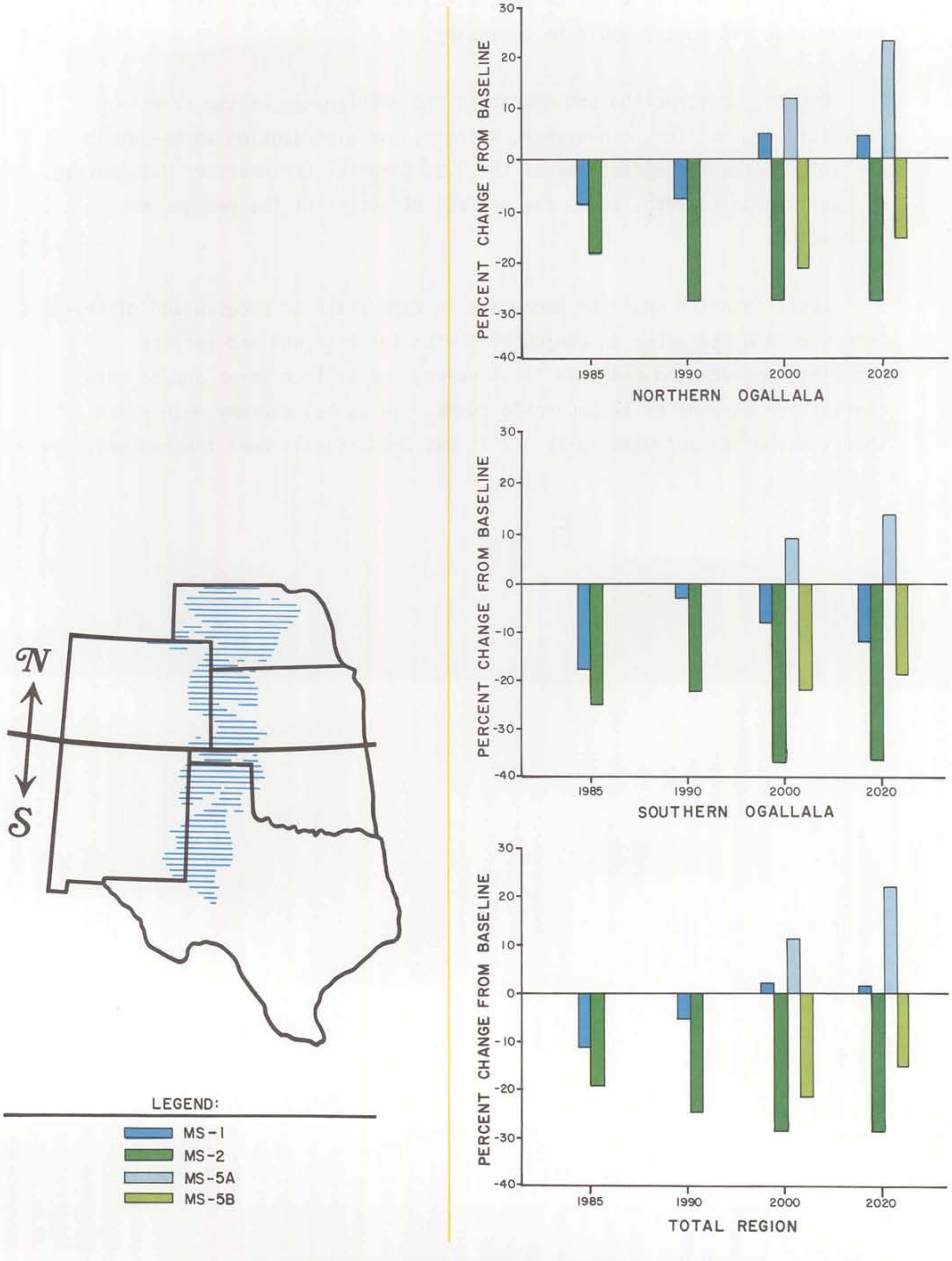


FIGURE VI-18: ALTERNATIVE MANAGEMENT STRATEGIES WATER REMAINING IN STORAGE WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

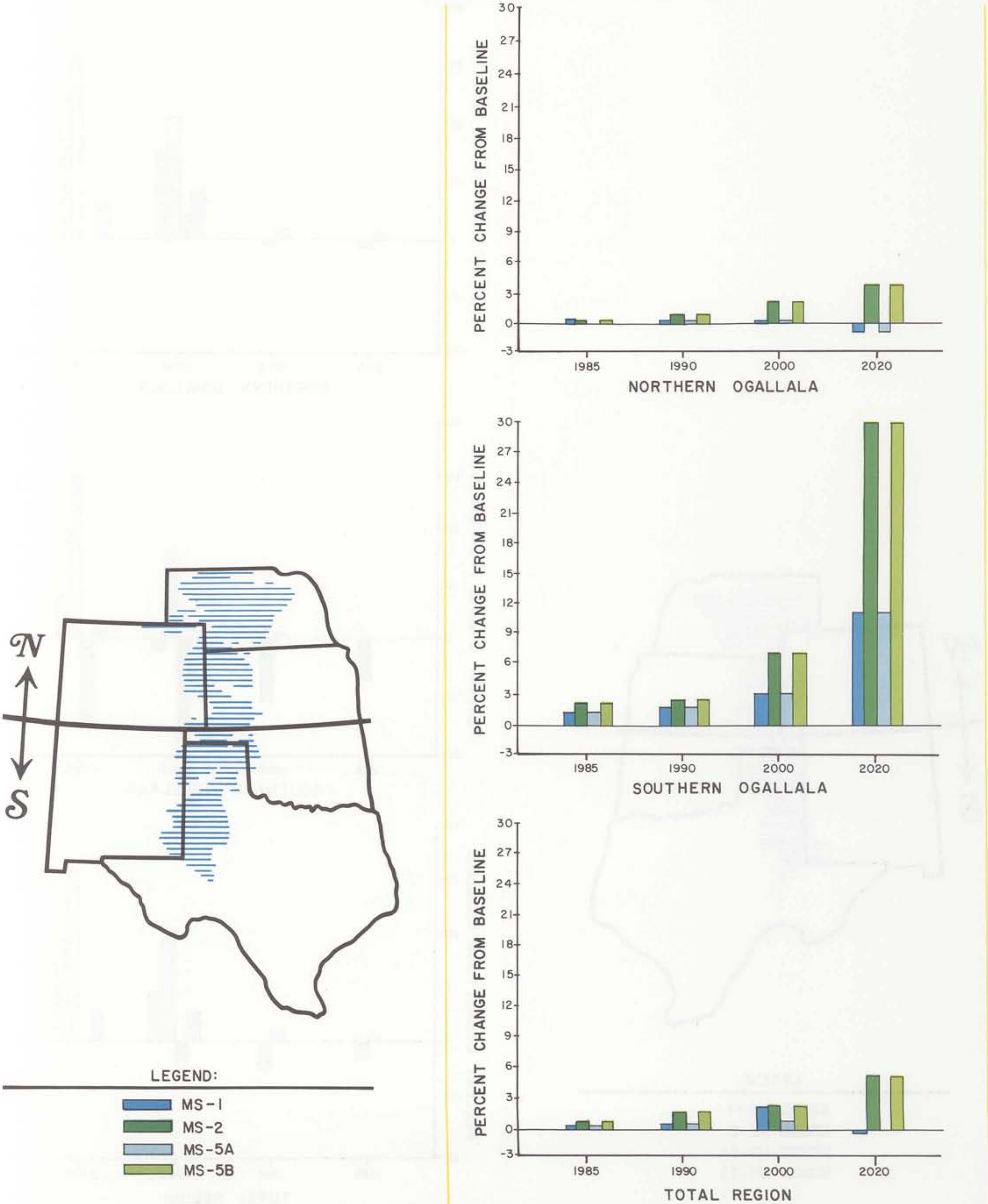


FIGURE VI-19: ALTERNATIVE MANAGEMENT STRATEGIES IRRIGATED ACREAGE WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

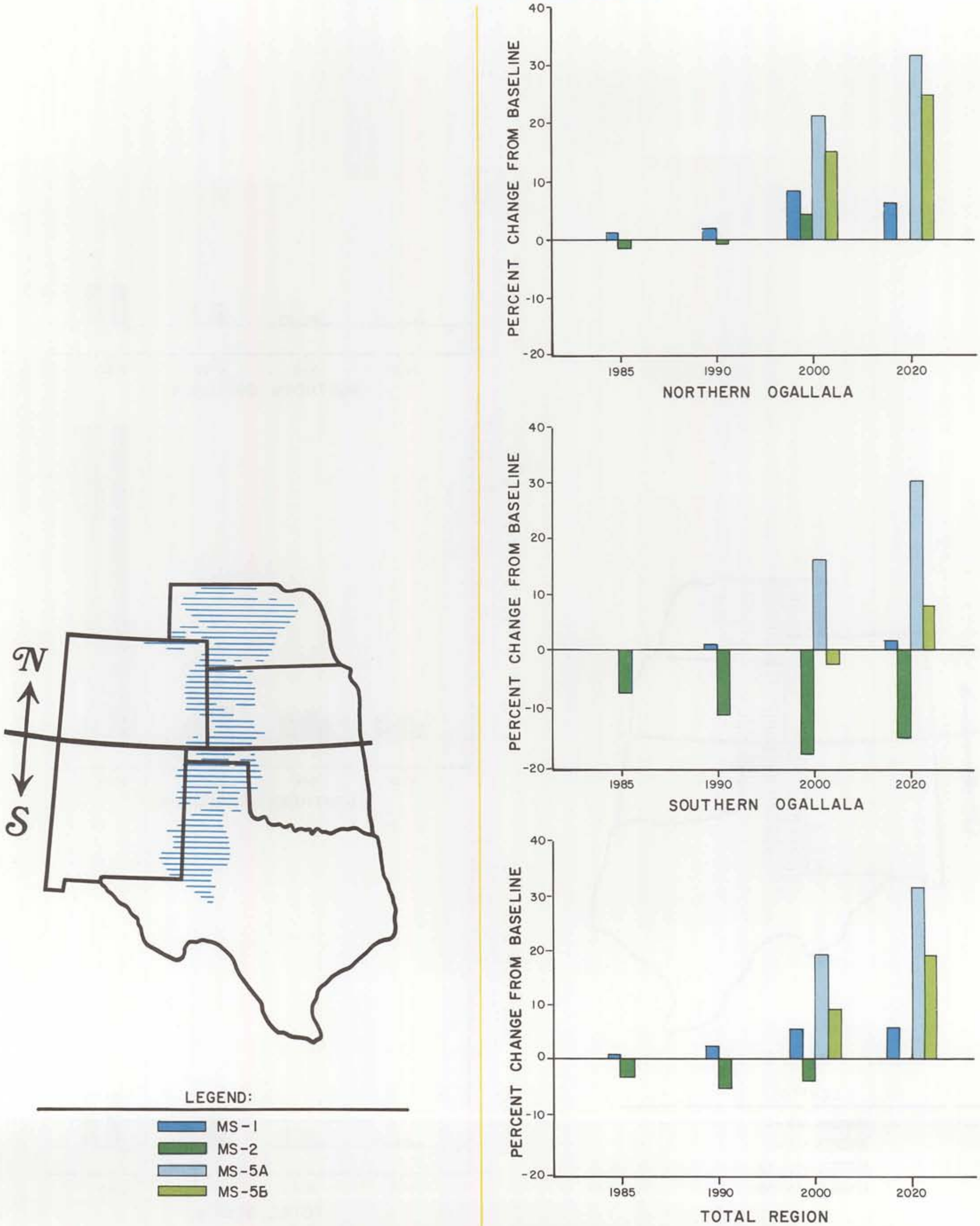


FIGURE VI-20: ALTERNATIVE MANAGEMENT STRATEGIES DRYLAND ACREAGE WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

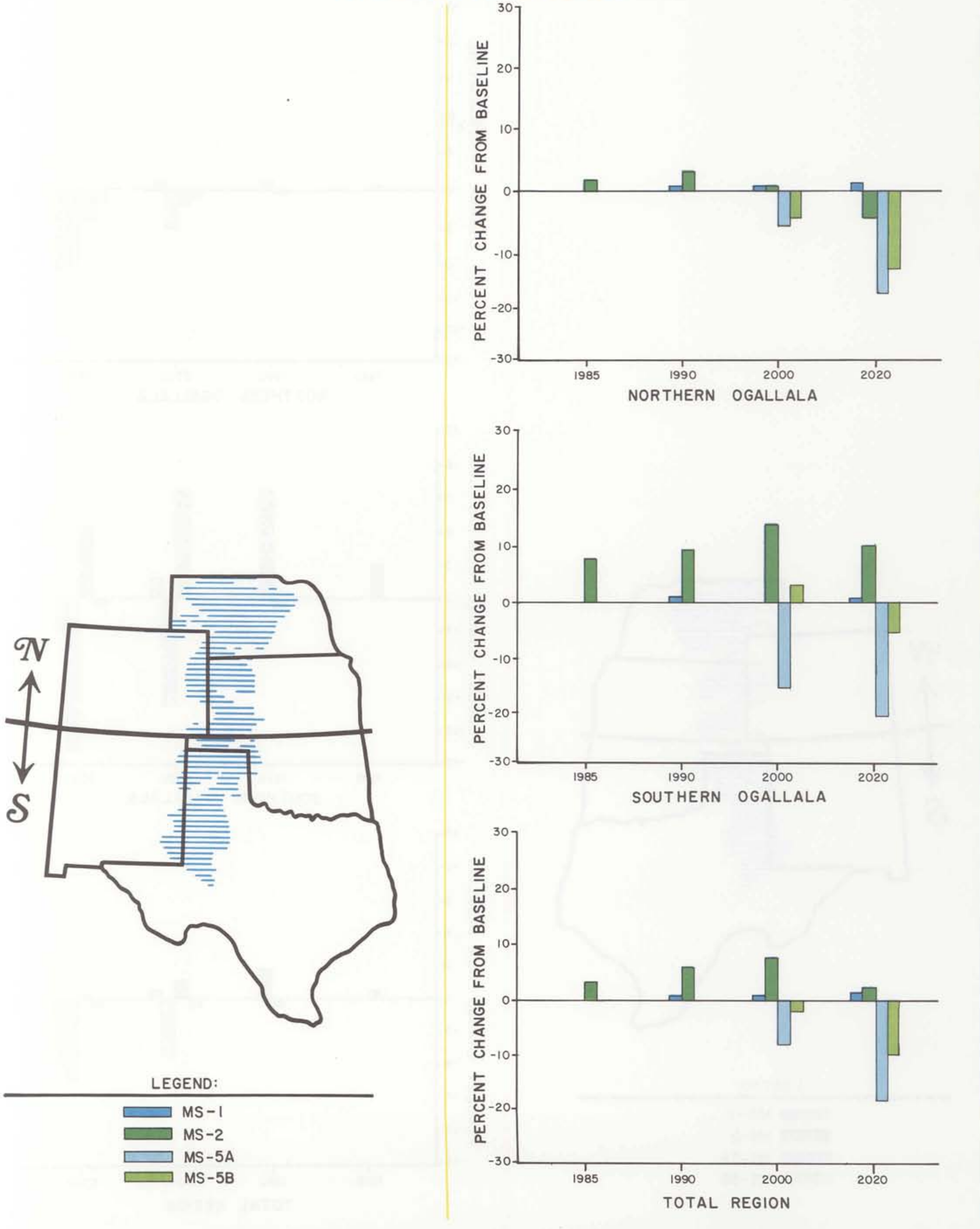


FIGURE VI-21: ALTERNATIVE MANAGEMENT STRATEGIES WHEAT PRODUCTION WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

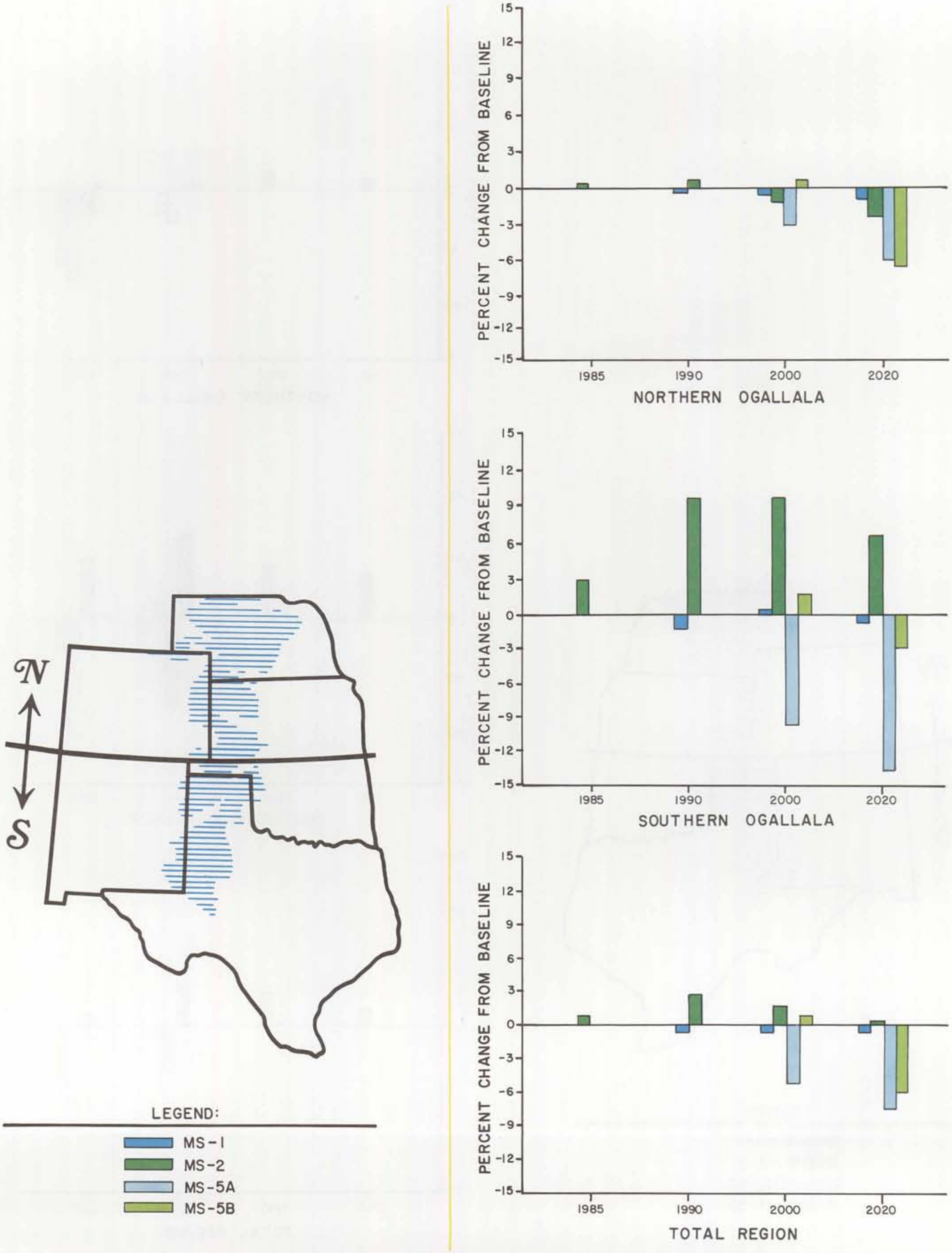


FIGURE VI-22: ALTERNATIVE MANAGEMENT STRATEGIES CORN PRODUCTION WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

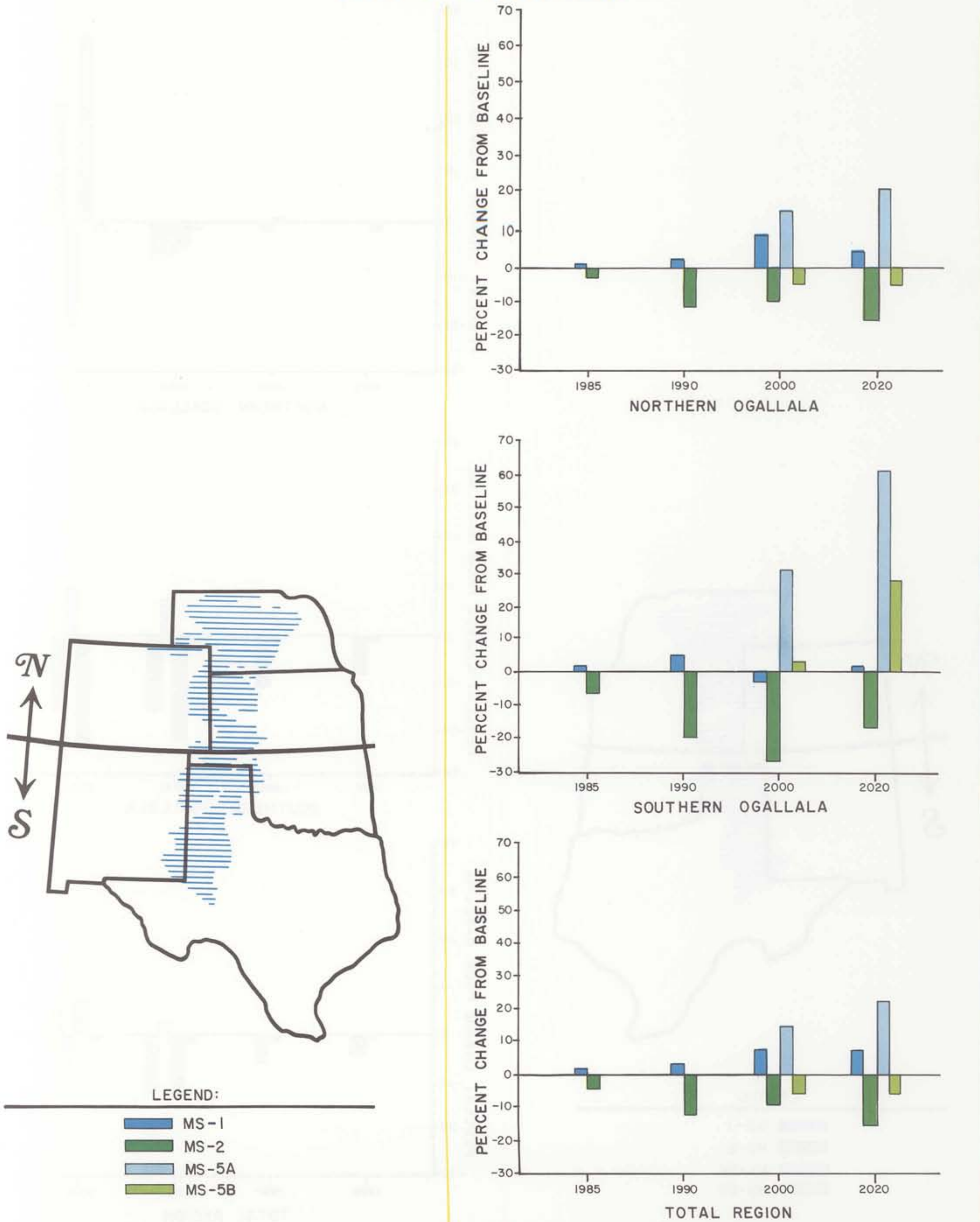
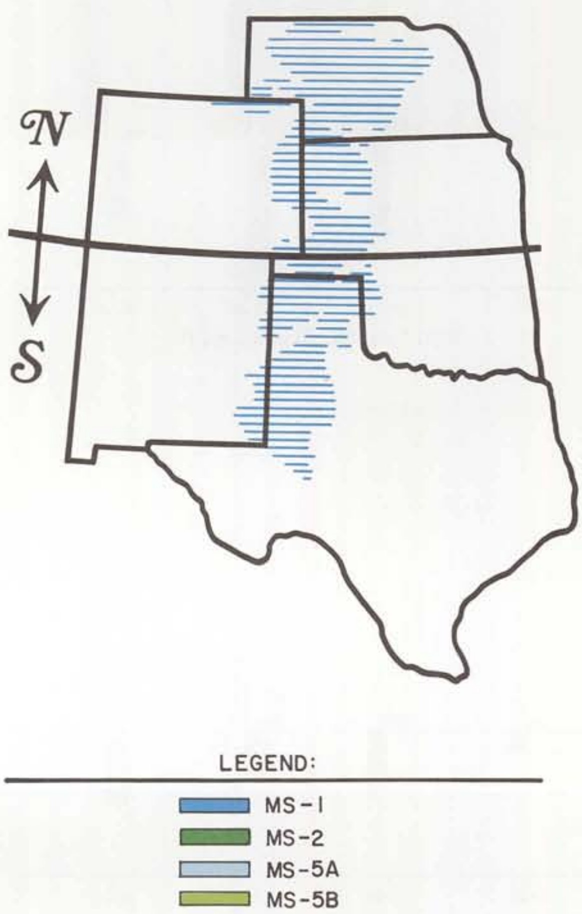


FIGURE VI-23: ALTERNATIVE MANAGEMENT STRATEGIES SORGHUM PRODUCTION WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION



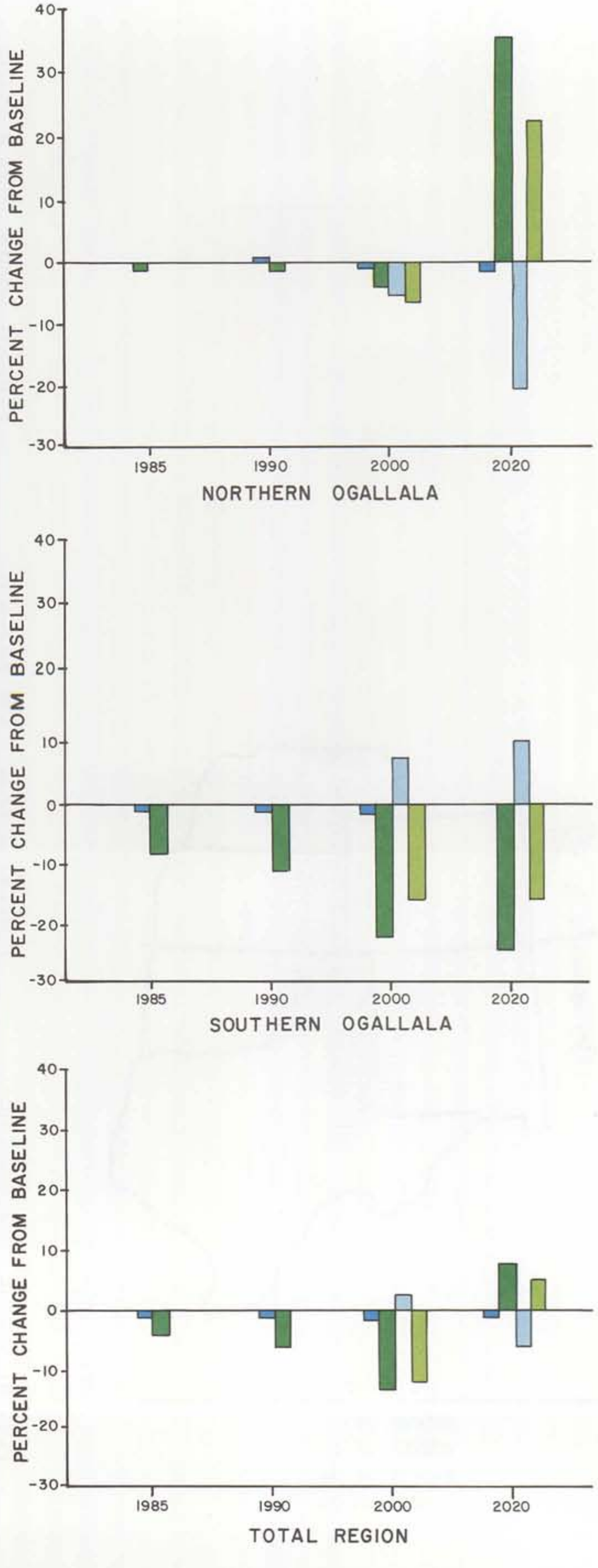
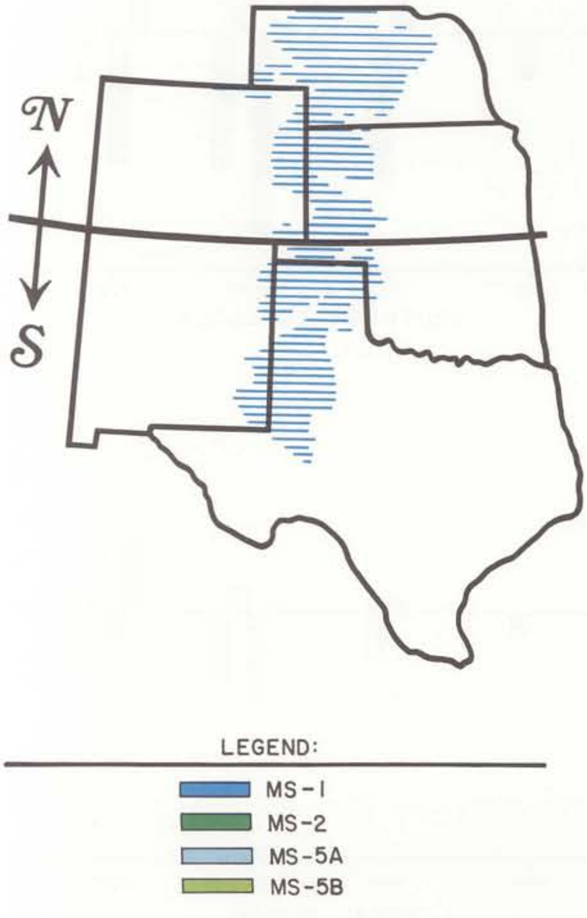
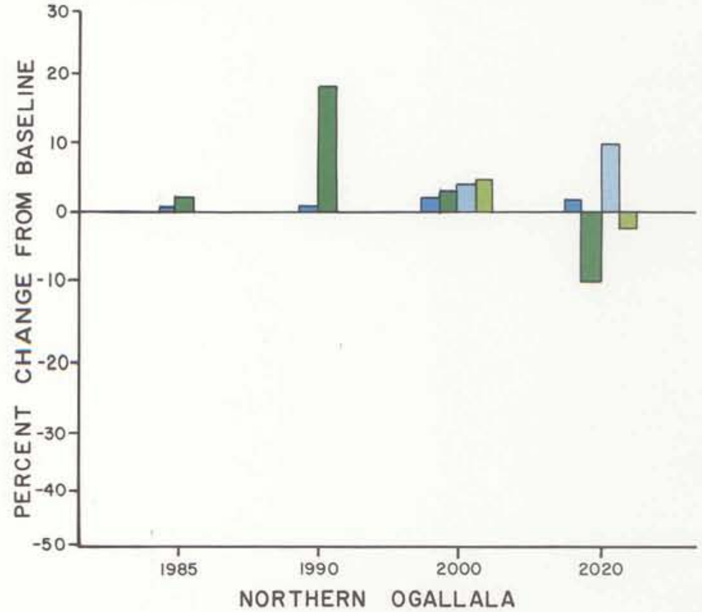
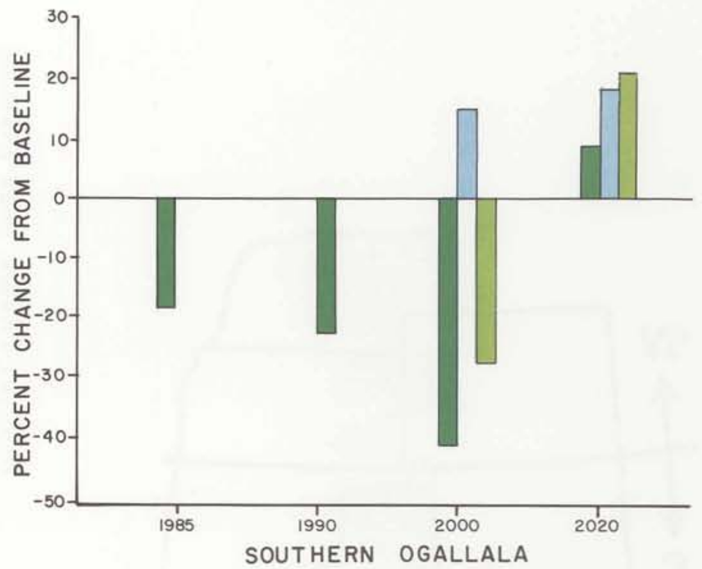


FIGURE VI-24: ALTERNATIVE MANAGEMENT STRATEGIES SOYBEAN PRODUCTION WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION







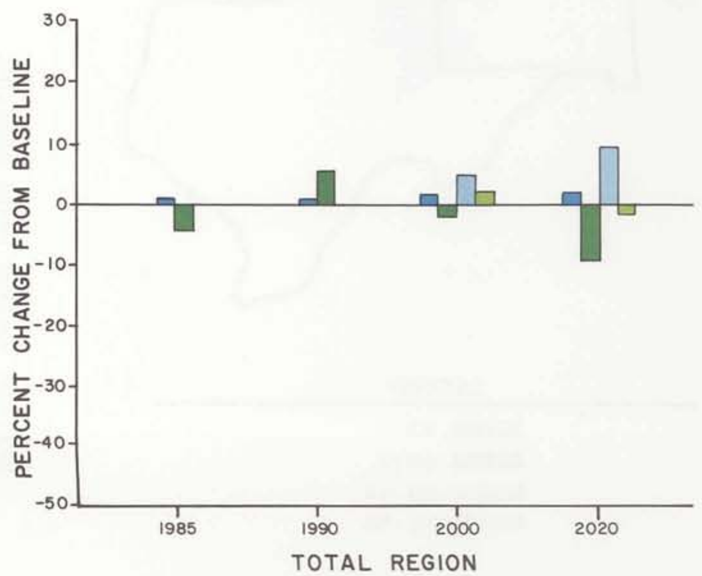


FIGURE VI-25: ALTERNATIVE MANAGEMENT STRATEGIES ALFALFA PRODUCTION WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

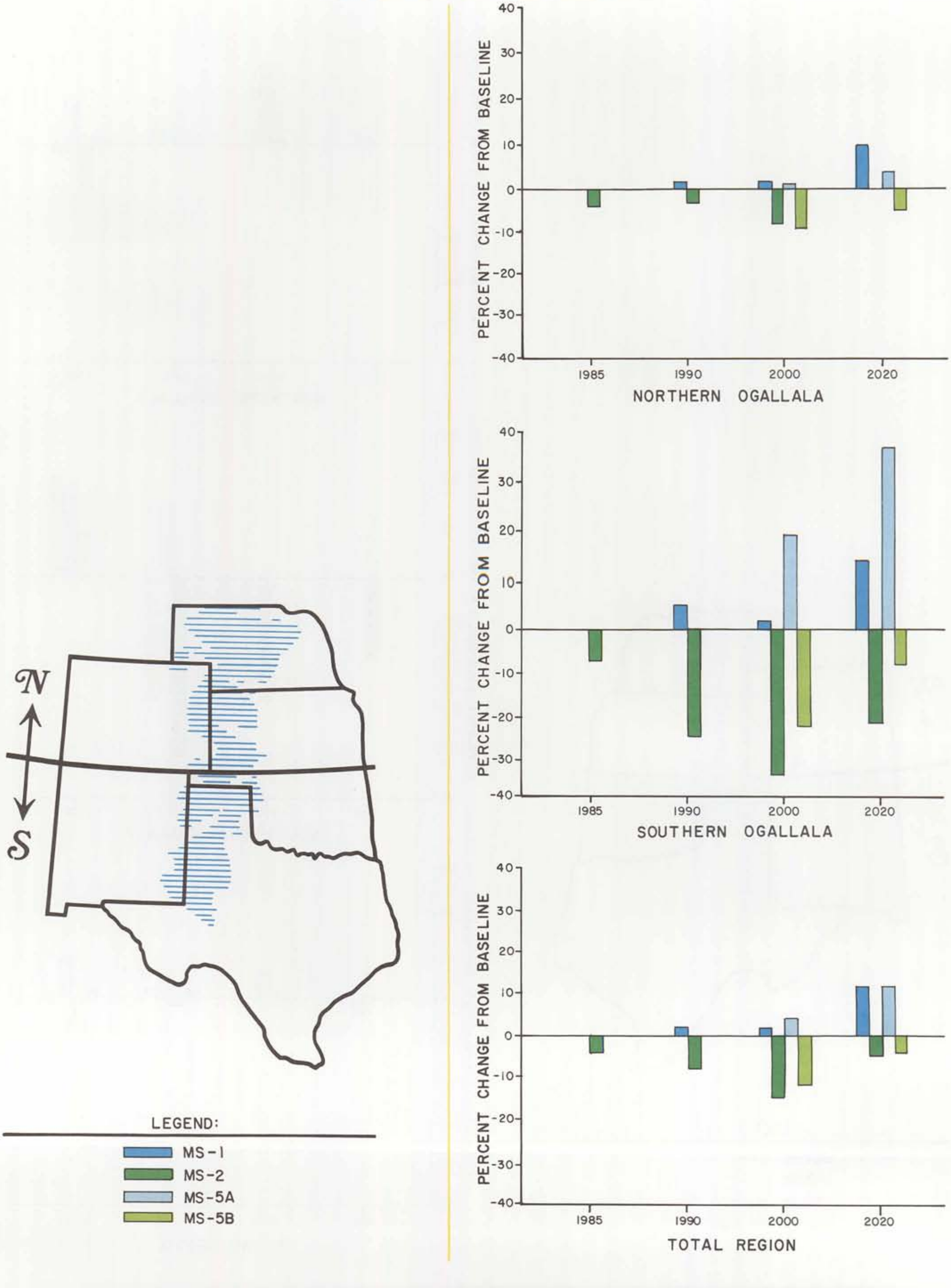


FIGURE VI-26: ALTERNATIVE MANAGEMENT STRATEGIES COTTON PRODUCTION WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

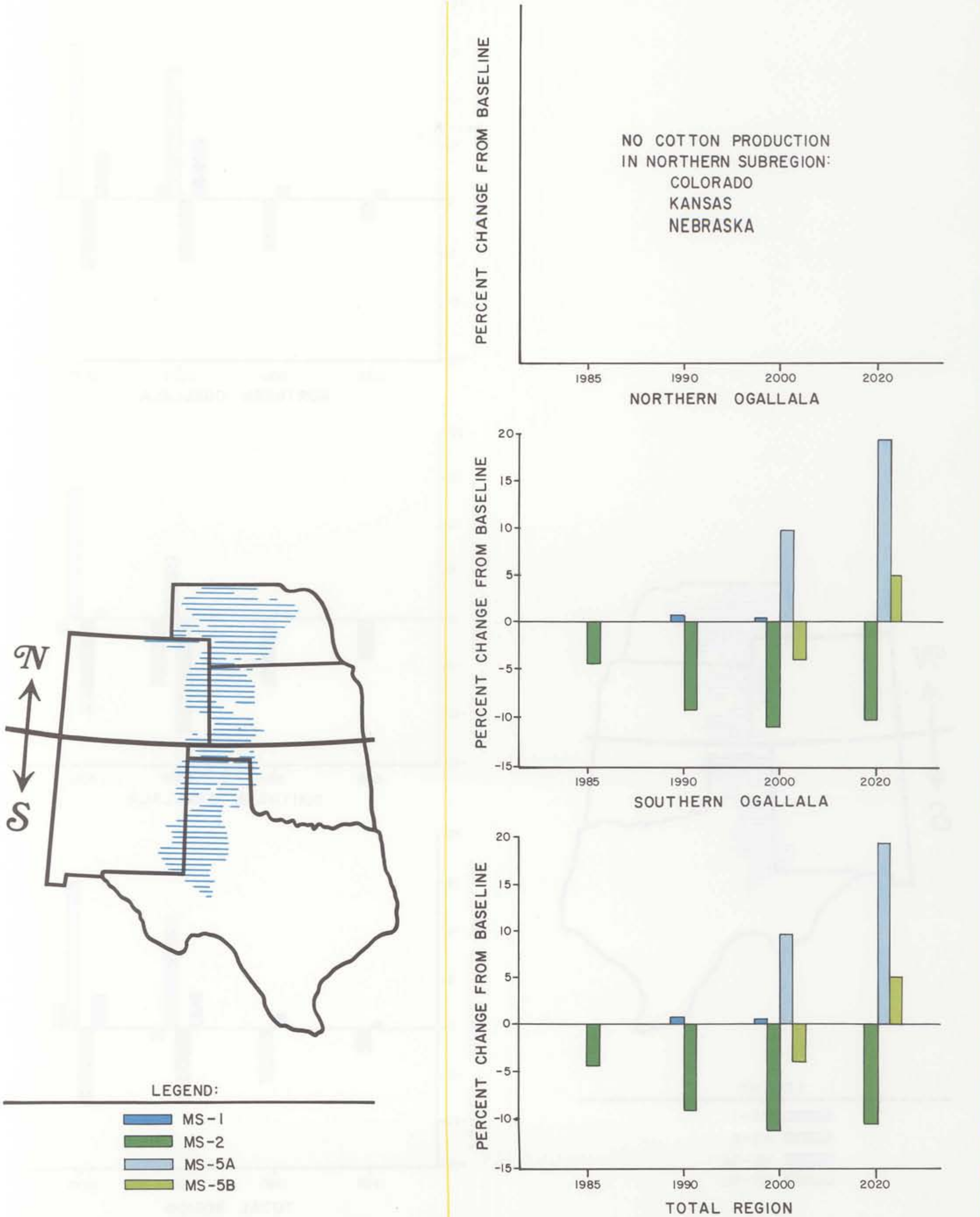


FIGURE VI-27: ALTERNATIVE MANAGEMENT STRATEGIES VALUE OF AGRICULTURAL PRODUCTION WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

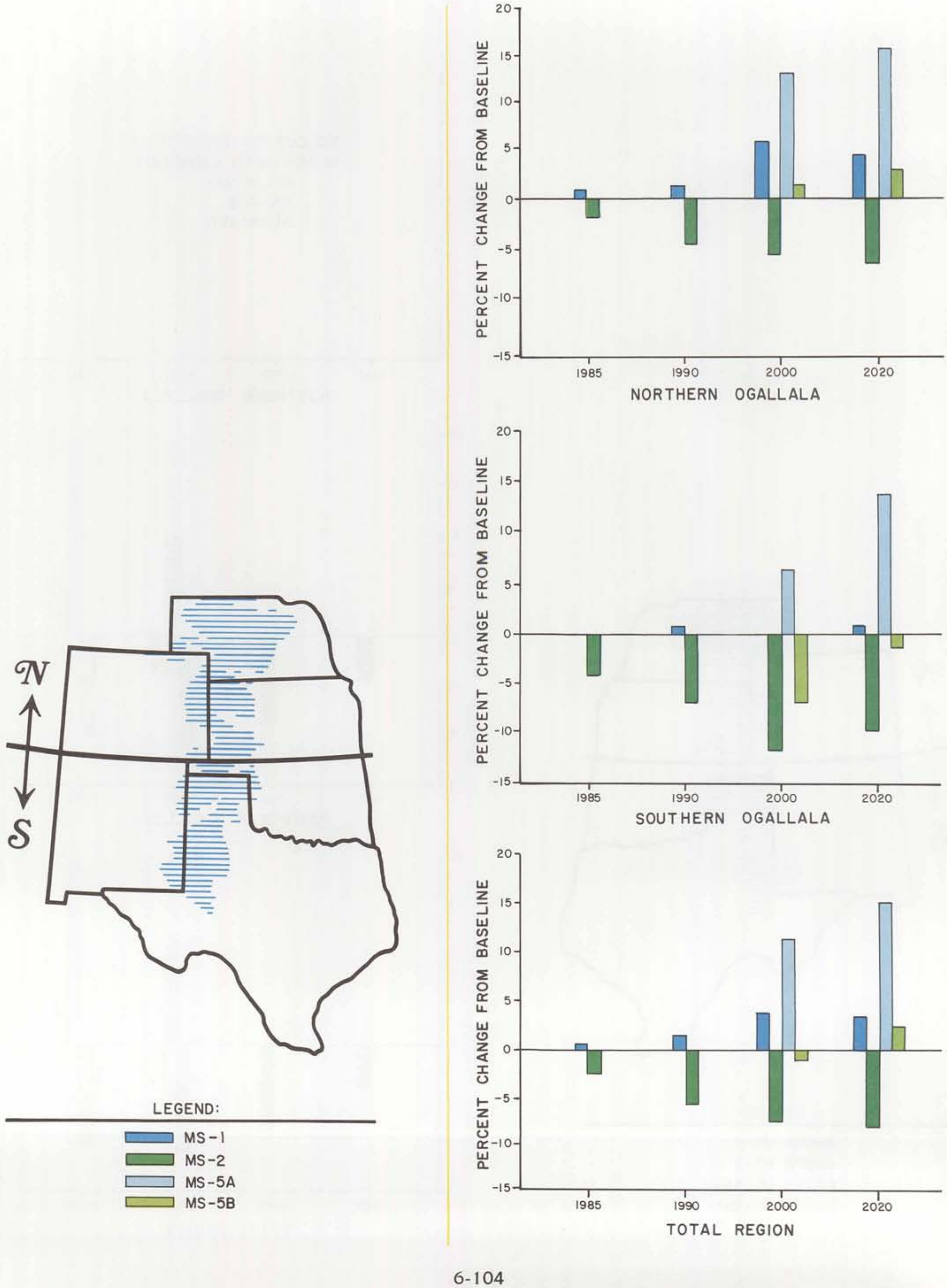
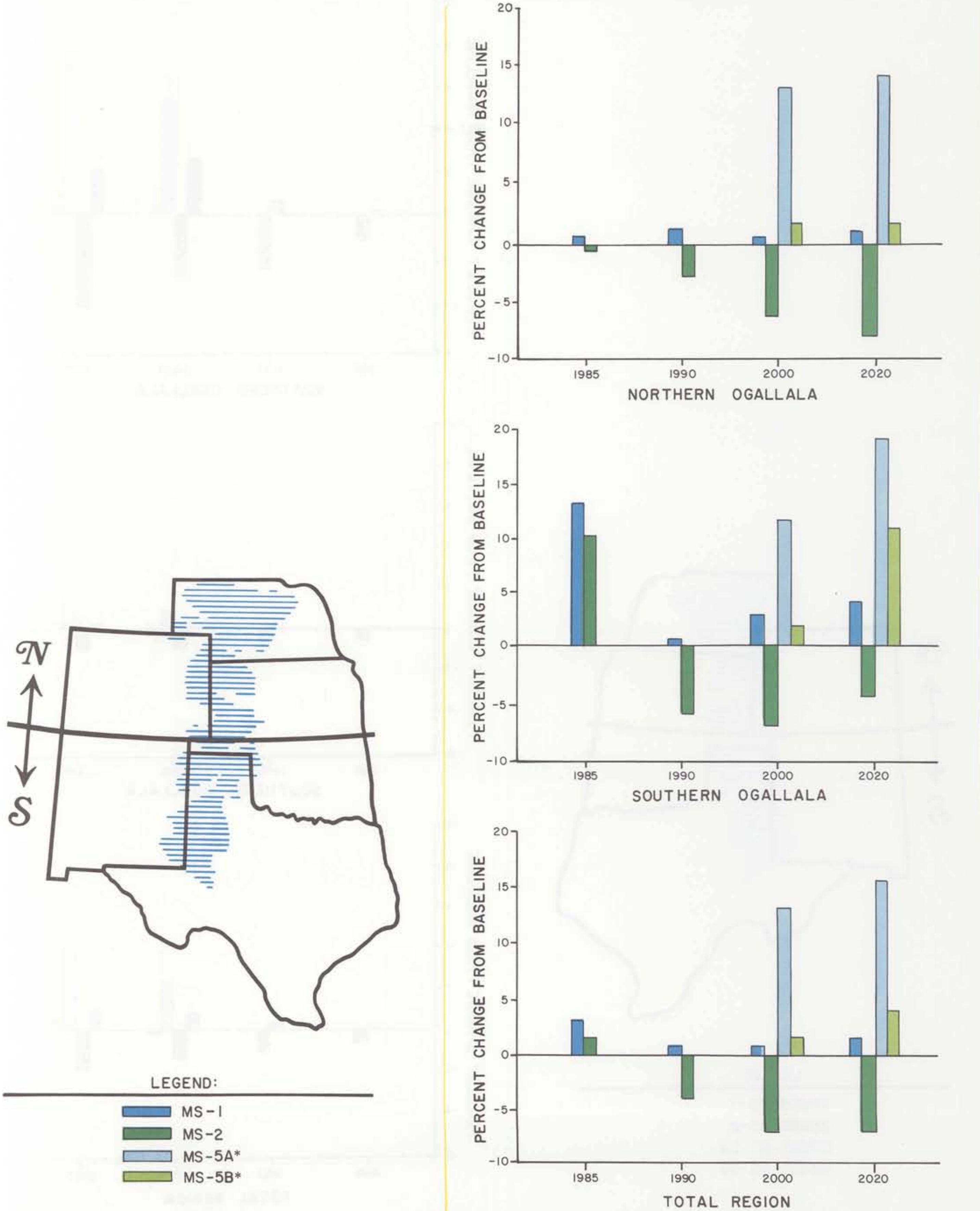


FIGURE VI-28: ALTERNATIVE MANAGEMENT STRATEGIES RETURNS TO LAND AND MANAGEMENT FROM AGRICULTURAL PRODUCTION WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION



*Returns include value of imported water.

FIGURE VI-29: ALTERNATIVE MANAGEMENT STRATEGIES TOTAL VALUE ADDED, ALL SECTORS WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

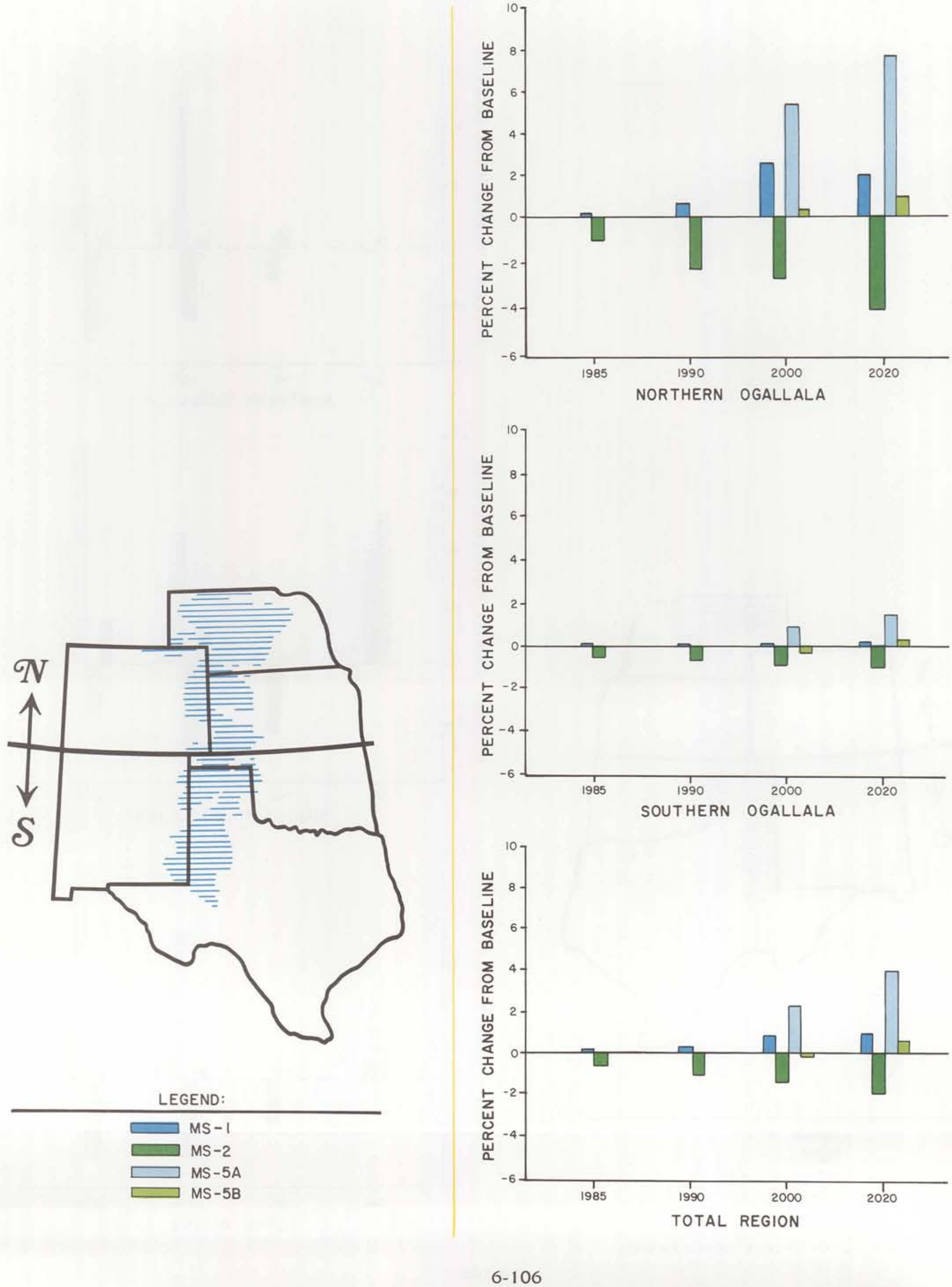
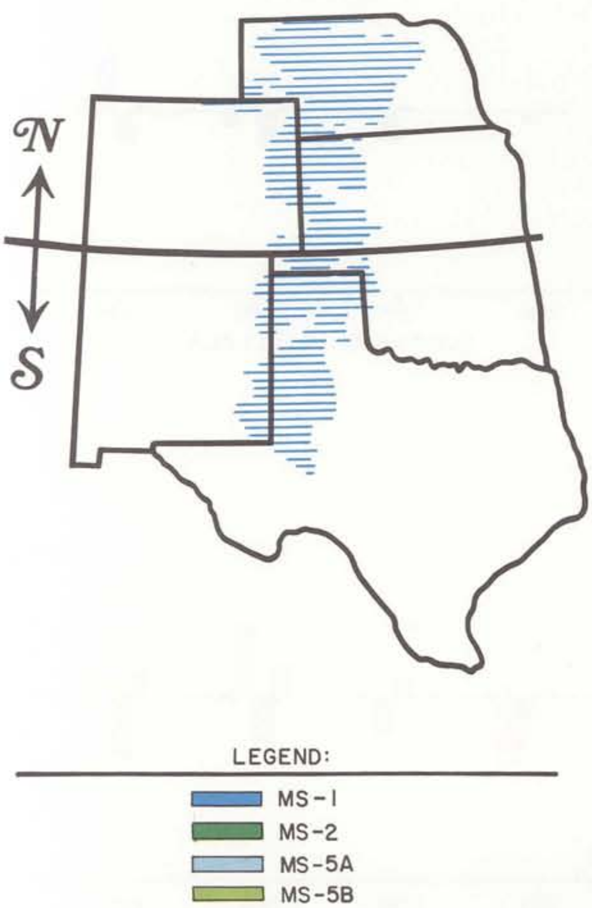
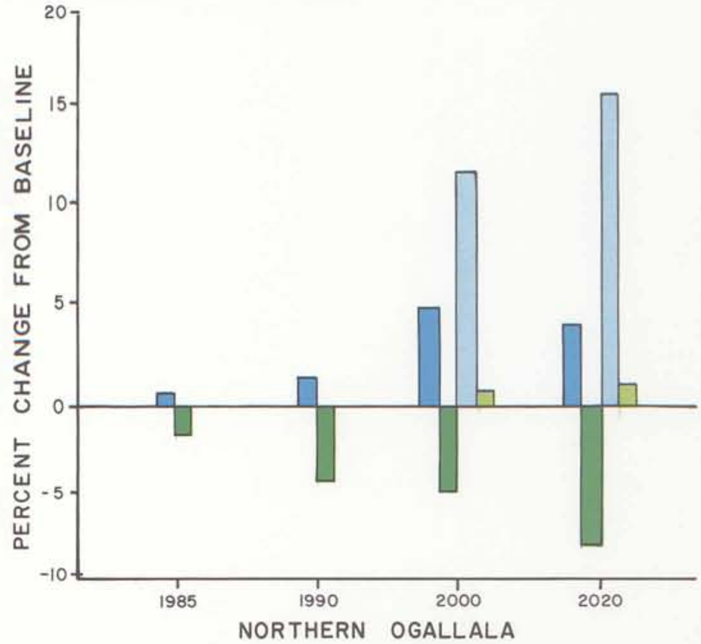
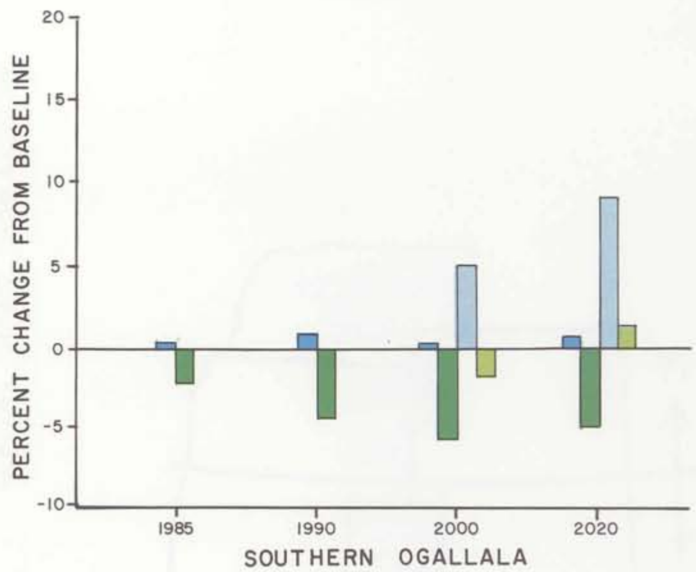


FIGURE VI-30: ALTERNATIVE MANAGEMENT STRATEGIES VALUE ADDED BY AGRICULTURAL RELATED SECTORS WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION







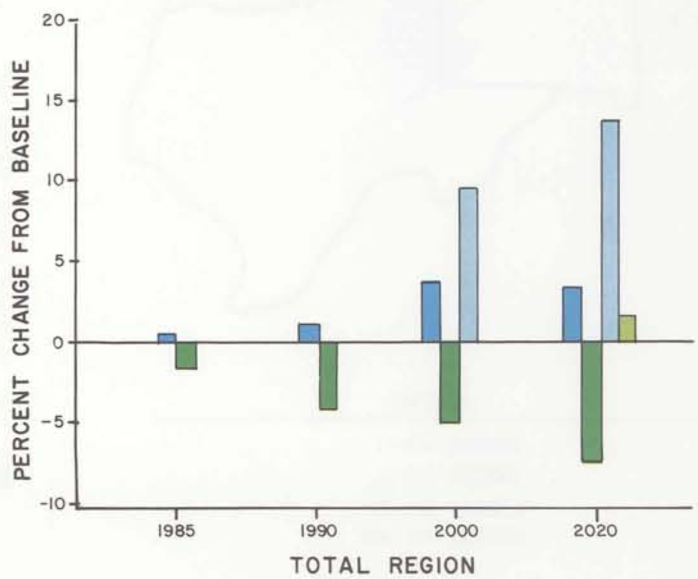
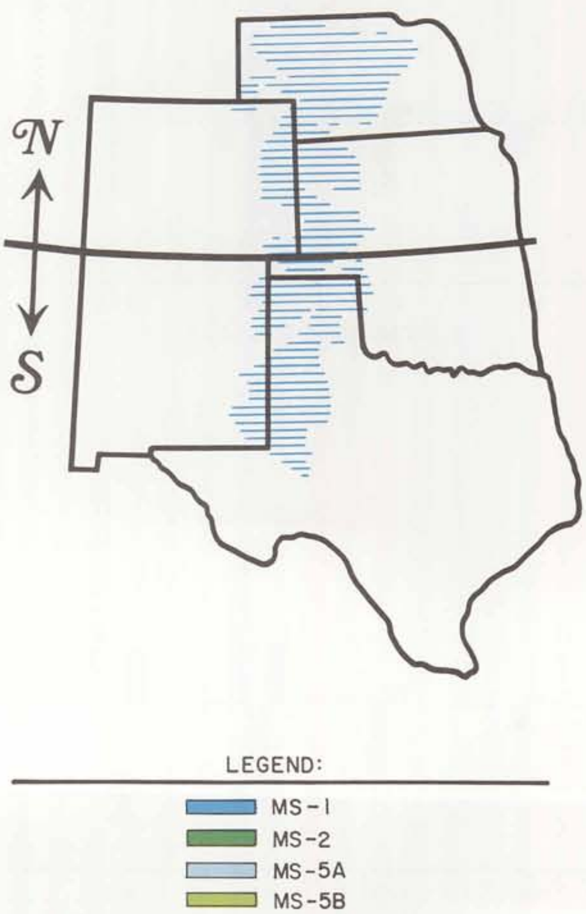


FIGURE VI-31: ALTERNATIVE MANAGEMENT STRATEGIES TOTAL EMPLOYMENT, ALL SECTORS WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION



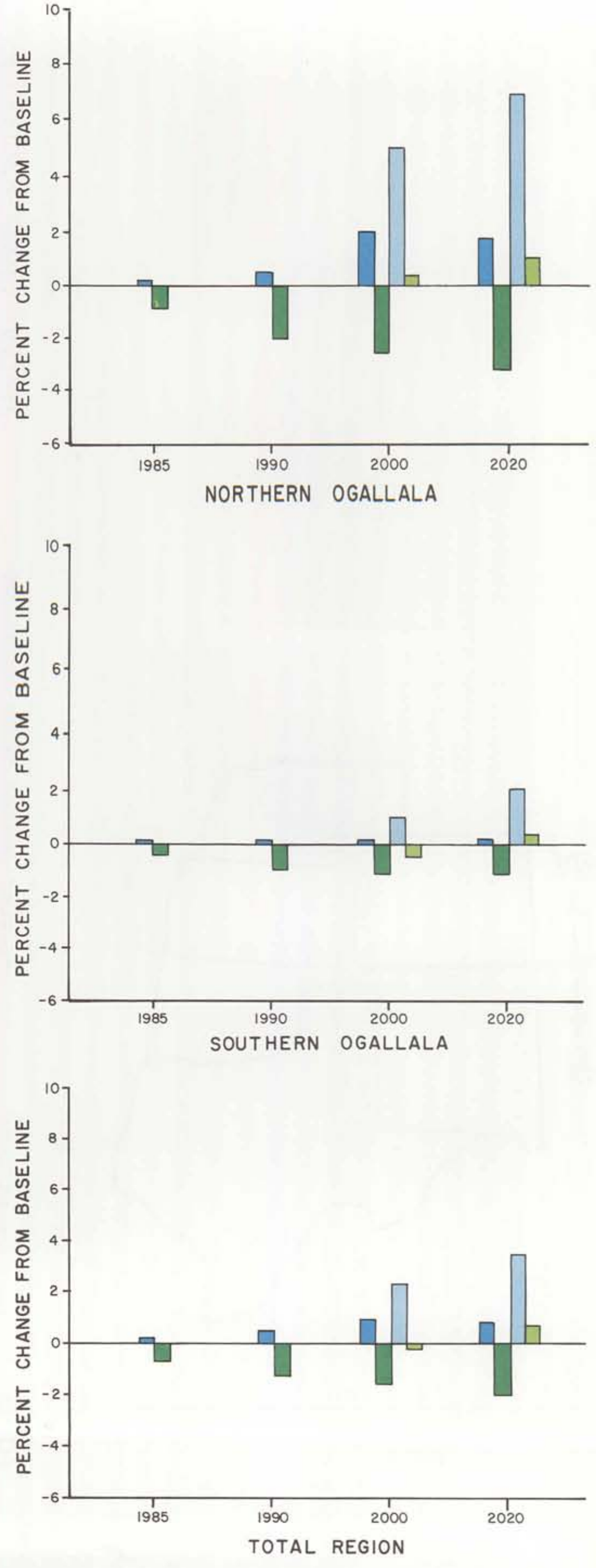


FIGURE VI-32: ALTERNATIVE MANAGEMENT STRATEGIES TOTAL HOUSEHOLD INCOME, ALL SECTORS WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION

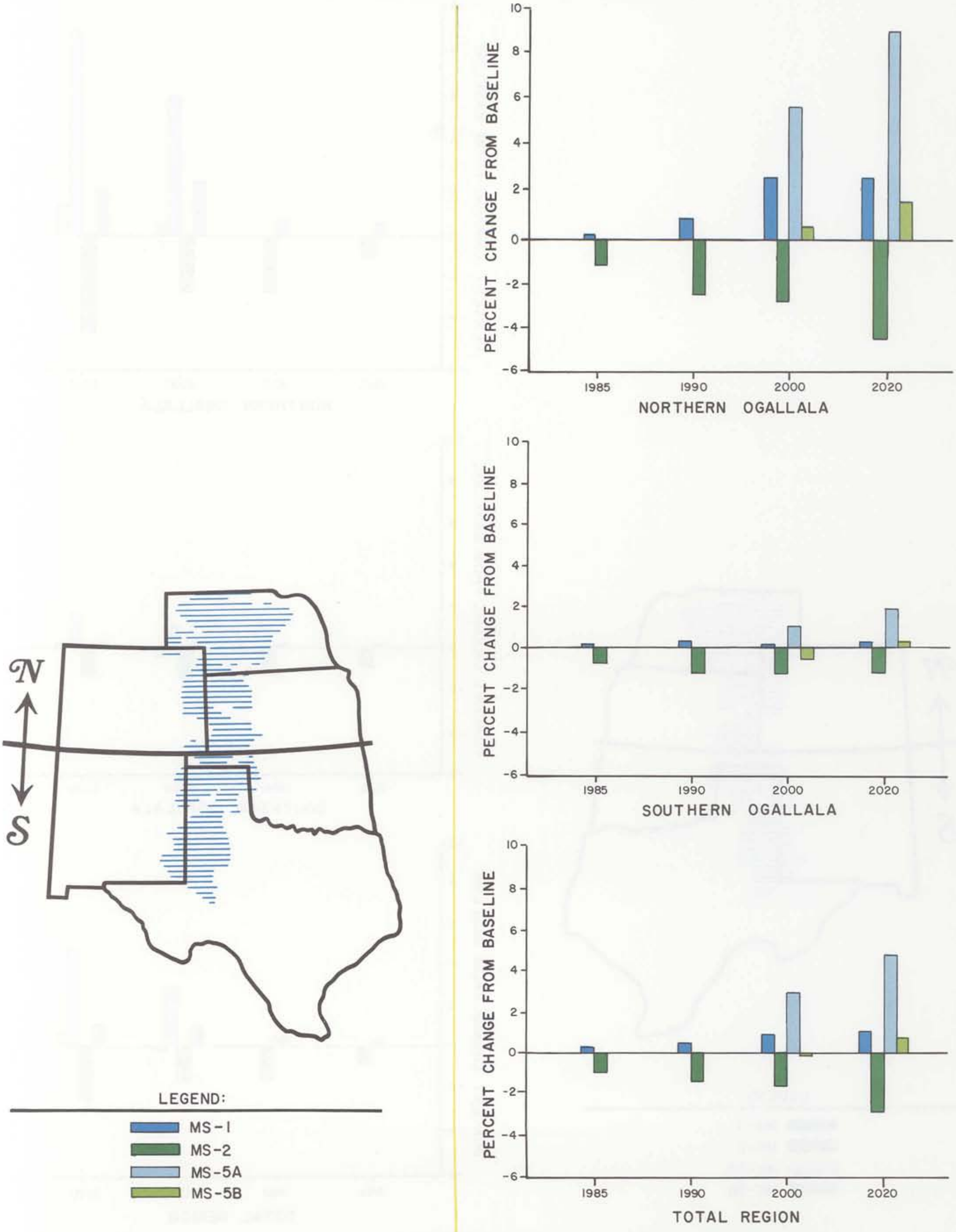
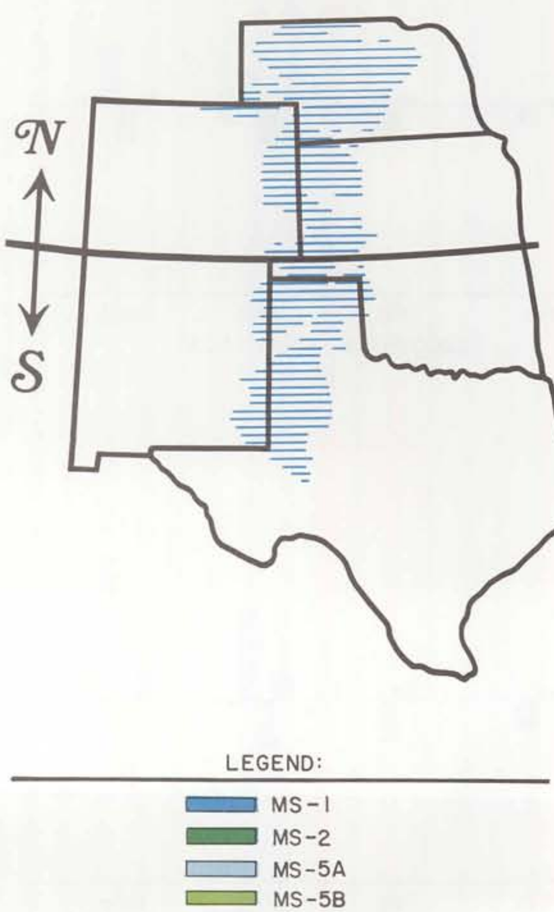
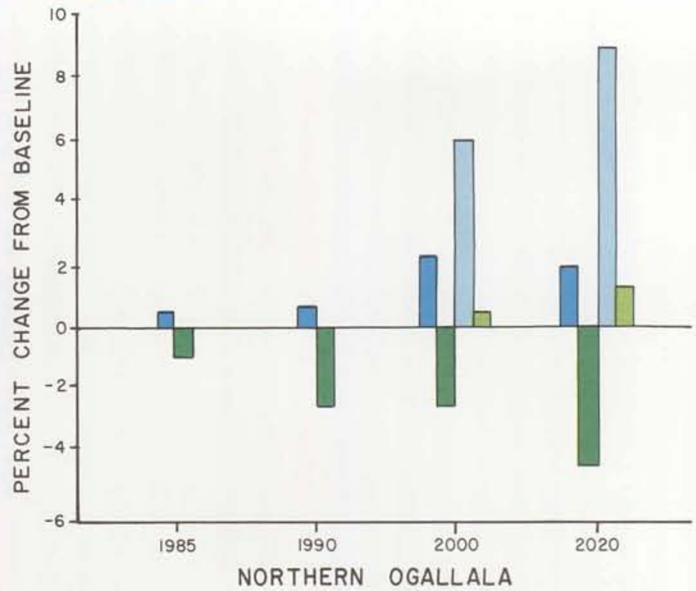
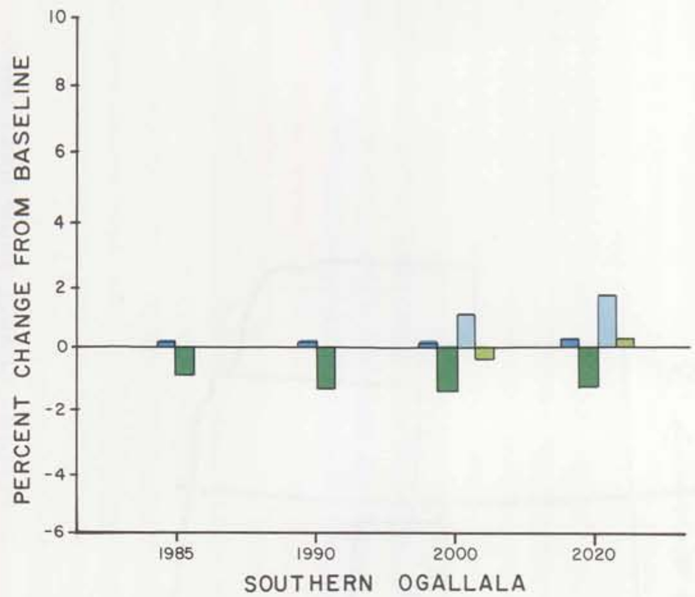


FIGURE VI-33: ALTERNATIVE MANAGEMENT STRATEGIES POPULATION PROJECTIONS WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION







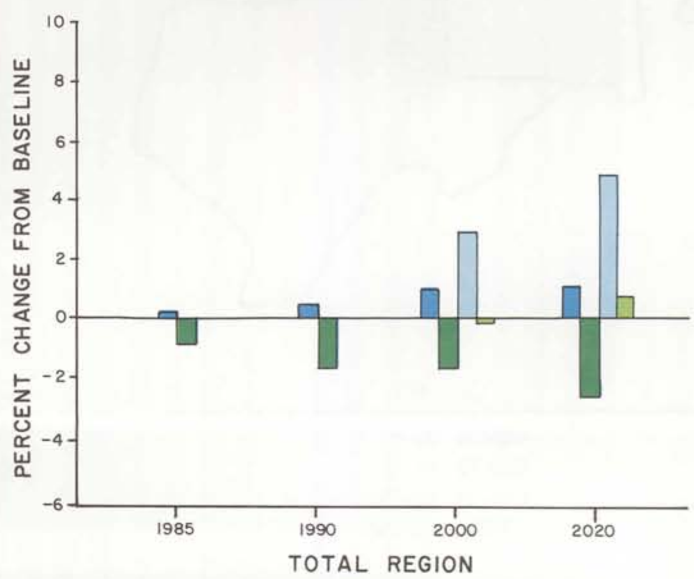
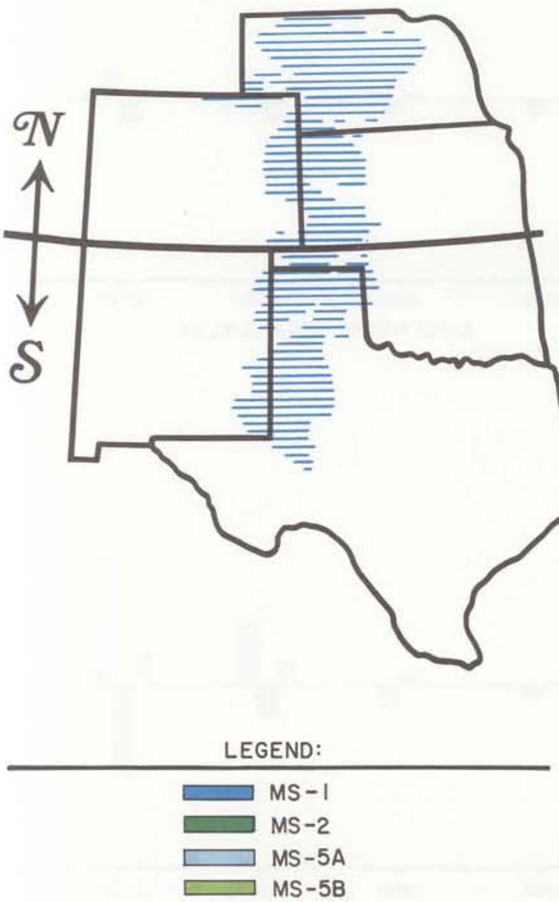


FIGURE VI-34: ALTERNATIVE MANAGEMENT STRATEGIES AVERAGE PER CAPITA INCOME WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION



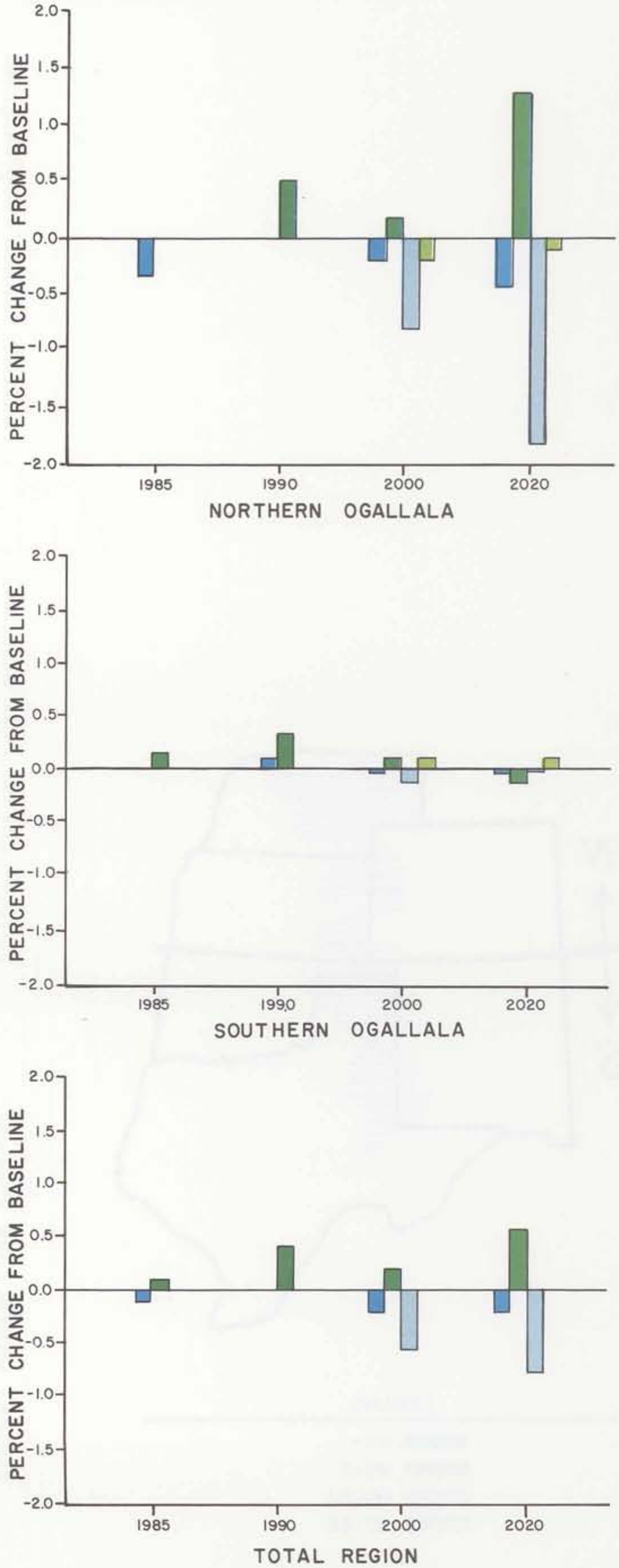
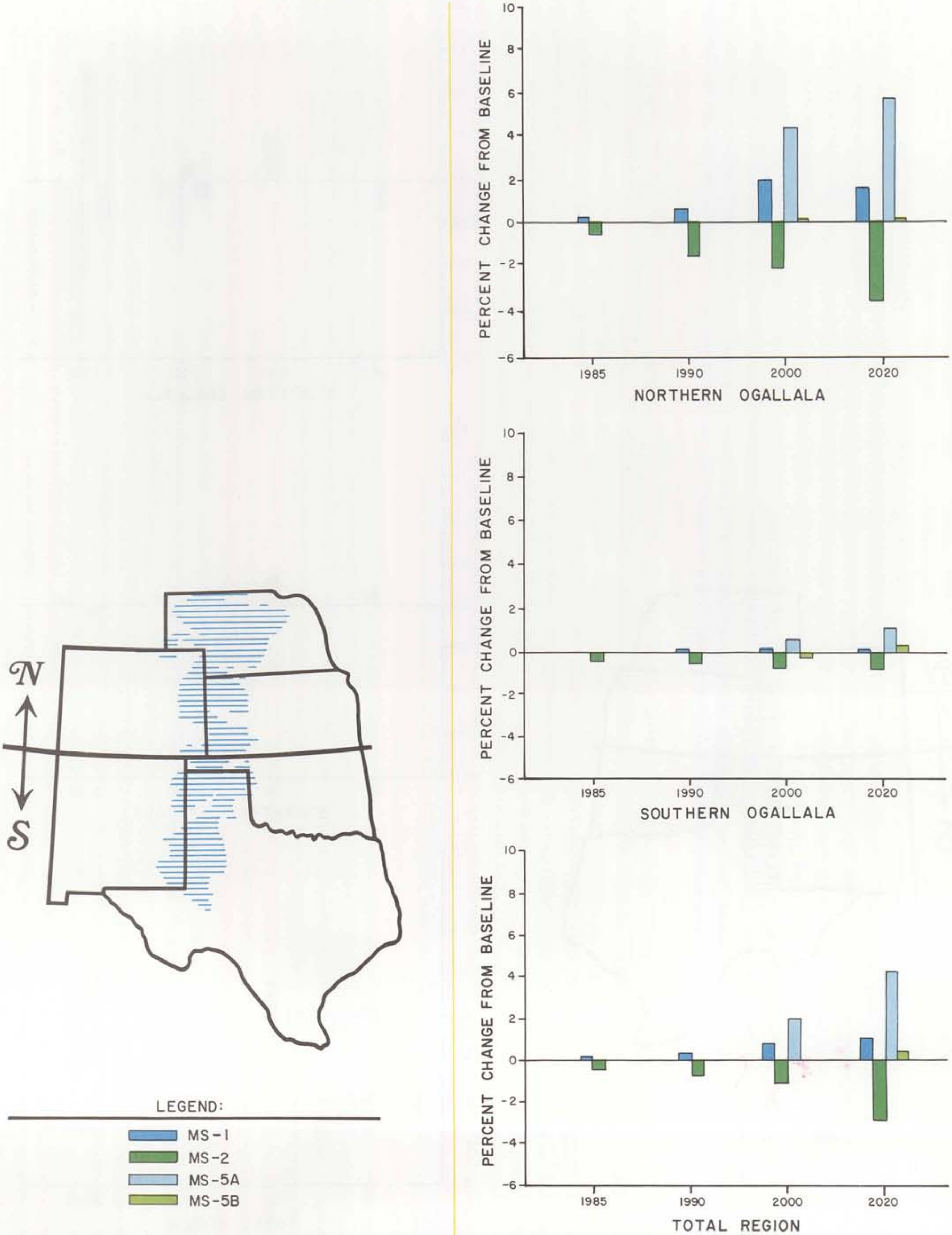


FIGURE VI-35: ALTERNATIVE MANAGEMENT STRATEGIES STATE AND LOCAL GOVERNMENT REVENUES WITH COMPARISON (PERCENT CHANGE) TO BASELINE PROJECTIONS FOR 1985, 1990, 2000 AND 2020, BY SUBREGION AND REGION



APPENDIX "A"

FORECASTING MODELS AND METHODOLOGY
USED IN
THE HIGH PLAINS STUDY

APPENDIX A: FORECASTING MODELS AND METHODOLOGY USED IN THE HIGH PLAINS STUDY

THE PROBLEM

To provide a comprehensive analysis of different policy choices for the High Plains Region over a forty-year period, the Study required an approach which would accommodate inevitable change in a wide range of variables during this period, yet provide an objective estimate of different water management strategies. Because of the pervasive influence of agriculture in the Region and because of the interrelation between water supply and agricultural production, the analytic approach selected must simulate the decisions which a farmer will make with regard to different conditions of water supply. The water use decisions must be accounted for in estimates of the remaining supply of water in the Aquifer.

Crop production resulting from these decisions at the farm level has a ripple effect in many sectors of the regional economy which use farm products or provide farm inputs. At the same time, the regional economy is driven by a variety of factors outside agriculture, notably the production of energy resources, so regional estimates of economic growth must be based on the full range of economic activities, not just those dependent on agriculture. The study required a method to aggregate the results of these diverse regional economic forces.

Because High Plains agriculture is a significant portion of national production in the major field crops, it was necessary to estimate the national effects of the different levels of production resulting from different water management strategies. A method for predicting changes in national crop prices, consumer food prices, and available export surplus was required.

More important than the absolute amounts of regional production, regional economic activity, or national prices, were the differences in these values between strategies. The analysis is basically an impact analysis, measuring the change in certain key variables in order to evaluate different water management strategies. Nevertheless, for the projected changes in key variables to be consistent, the overall methodology required:

- ° Consistent interrelationships between national and regional economic data.
- ° A minimal, common (and reasonable) set of assumptions about future events (economic, institutional, etc.).
- ° Clearly articulated projections of exogenous economic variables.
- ° Estimates of farm production which are sensitive to actual water supplies and cropping conditions in each part of the large Ogallala Region.
- ° Common economic parameters within which local agricultural production can be estimated.
- ° A systematic means of summarizing the net effects of all economic changes in the state and regional economy.

A set of interacting, closely linked economic models was selected, adapted, and developed to provide estimates of the <u>impacts</u> on regional agricultural production and economic activity. This set of interacting models is graphically depicted in Figure 1 and described in this Appendix.

From the outset of the Study, it was recognized that the complex of economic models developed for the impact analysis could not answer all the questions raised by those concerned about the future of the Region. For this reason, a series of separate stand-alone studies was developed to deal with these questions. These studies, published separately and sometimes referred to as the "B-series" served a variety of purposes. Some provided inputs to the core economic analysis:

- ° B-8 provided a forecast of energy prices (an input to farm production) and the level of activity in the energy sectors of the regional economy.

° Study element B-7 provided benchmark estimates of other (non-energy) farm input prices which were modified as appropriate in each Ogallala state.

° Study element B-2 projected the national impact of changing farm production in the Ogallala Region.

° Study element B-3 and B-5 reviewed the state-of-the-art technologies of water use and water supply augmentation.

Additional studies in the B-series provide important information for the overall consideration of policy alternatives, although the results are not easily tabulated in quantitative form. Results applicable to one or more water management strategies are included in the analysis and comparison of strategies. The reader with a significant interest in any topic included in one of these studies should refer to the complete report for the study element. The topics addressed include:

° Interbasin water transfer assessments.

° Environmental assessment of different water management strategies (B-4).

° Analysis of the institutional requirements to implement each management strategy (B-6).

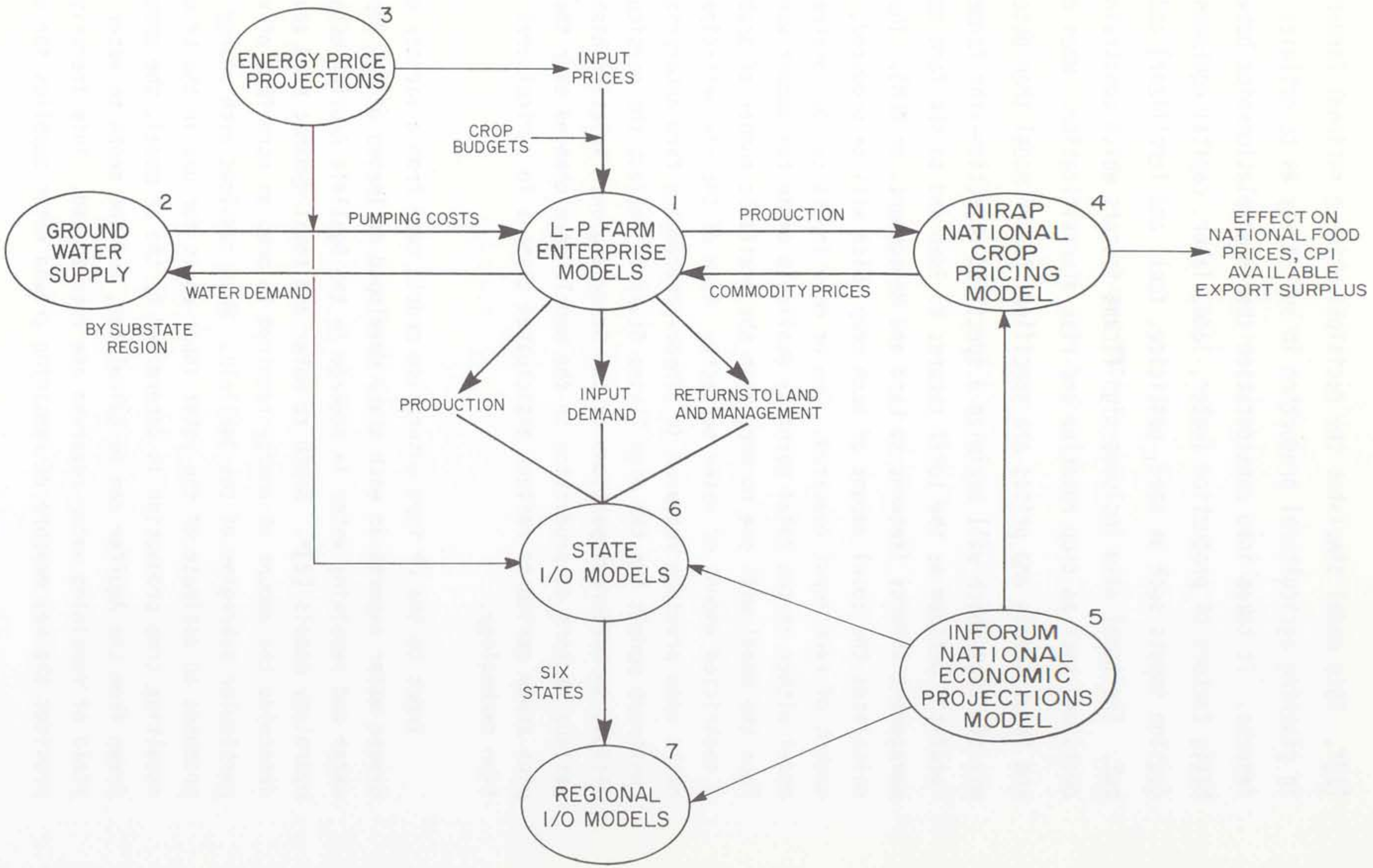
° Socioeconomic analysis of the effects of the transition to a dryland farming economy and the likely rate of such a transition (B-9).

° Examination of alternative economic development potential that the Region may realize to compensate for any decline in agricultural production (B-10).

INTERACTING ECONOMIC MODELS

Figure 1 shows the interacting models used to project the quantitative indicators of the impact of each water management strategy. At the heart of this complex is the linear-programming (LP) model of the farm enterprise

FIGURE 1: THE HIGH PLAINS STUDY INTERACTING MODELS AND DATA INPUTS



[1]*. This model simulates the decisions which a rational farmer would make in planning agricultural production in such a way as to optimize his net returns. It takes into consideration the interrelationships between the basic factors of production (water, land, labor, capital equipment and production inputs such as seed, pesticide, fuel, and fertilizer) and crop output. The model also includes significant factors which constrain cropping decisions such as crop rotation and risk diversification. When crop prices and input levels and prices are specified, the LP model then determines the mix of crops which will maximize a specified objective--the farmer's "profit", defined as the total returns to land and to the farm owner's management efforts (Returns to Land and Management, or RLM). The model calculates the total amount of each crop which will be produced, and the amount of each input required. One or more inputs can be constrained in the model either in the total quantity available or in the amount used per acre. Thus the model will use no more than the available number of arable acres or a restricted amount of water per acre. Each of the six participating states built upon previous research in linear-programming farm enterprise models to construct models for the High Plains Study to reflect the particular conditions in different portions of the Study Region. Relationships between the various factors of production in the models were changed over the forty-year plus study period to reflect anticipated changes in agricultural and irrigation technology.

Input to the LP farm enterprise models came from a variety of sources. Ground water experts in each state developed estimates of the depth to ground water and remaining water in storage in the Ogallala Aquifer using state hydrology models [2]*. Depth to water and total dynamic head are used to determine the amount of energy required to pump an acre-foot of water in a particular subregion of the Ogallala. When combined with energy prices, this produces an estimate of the water input costs for use in the LP models. When resulting crop production is determined by the LP model, the amount of water drawn from the Aquifer can be calculated, and the depth to water and the well yield of remaining water reserves are reestimated. This iterative process provides the key measure of remaining ground water supplies for each

* Numbers in brackets refer to the corresponding numbered models or activities in Figure 1.

strategy. When the ground water is exhausted by this process, the LP model automatically reverts to dryland farming (water available for irrigation is constrained to zero) except in Strategy Five, where imported surface water becomes available under specified policies.

Projections of primary energy commodity prices were required in order to determine the value of future crude oil and natural gas production in the Study area. Projections were also required of end-use energy commodity prices for use in the LP farm enterprise models [3]*. Black & Veatch developed a consistent set of primary energy commodity and end-use energy commodity price projections for the Study. The projections and the methodologies used to make the projections are documented in the B-8 report.

The methodology developed for making the price projections is schematically illustrated in Figure 2. The methodology attempts to maintain a long-term perspective with regard to relative price changes and product pricing relationships while accounting for recent events judged to have permanently altered the long-term price trends. The potential of recent federal energy legislation and new energy supply technologies to affect energy commodity prices was evaluated, and a review of the permanence and impact of long-term energy supply contracts was made. These assessments were considered in developing the three separate sets of price projections: (1) primary energy commodity prices, (2) petroleum and natural gas product prices, and (3) electricity prices. Table 1 summarizes the projections; the principal considerations for each set of projections are briefly discussed in the following paragraphs.

Projections of wellhead crude oil and natural gas prices and coal prices f.o.b. mine were made using the long-term price trend of crude oil and coal. Based on the historical price trends shown in Figure 3, the future price of crude oil was projected based on current (March 1980) world crude oil prices and taking into account the decontrol of domestic crude oil prices by 1985. Wellhead natural gas prices were projected using the crude oil price projections and assuming realization of the intent of the Natural Gas Policy Act of 1978.

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* See Figure 1.

FIGURE 2: HIGH PLAINS STUDY ENERGY PRICE PROJECTION METHODOLOGY

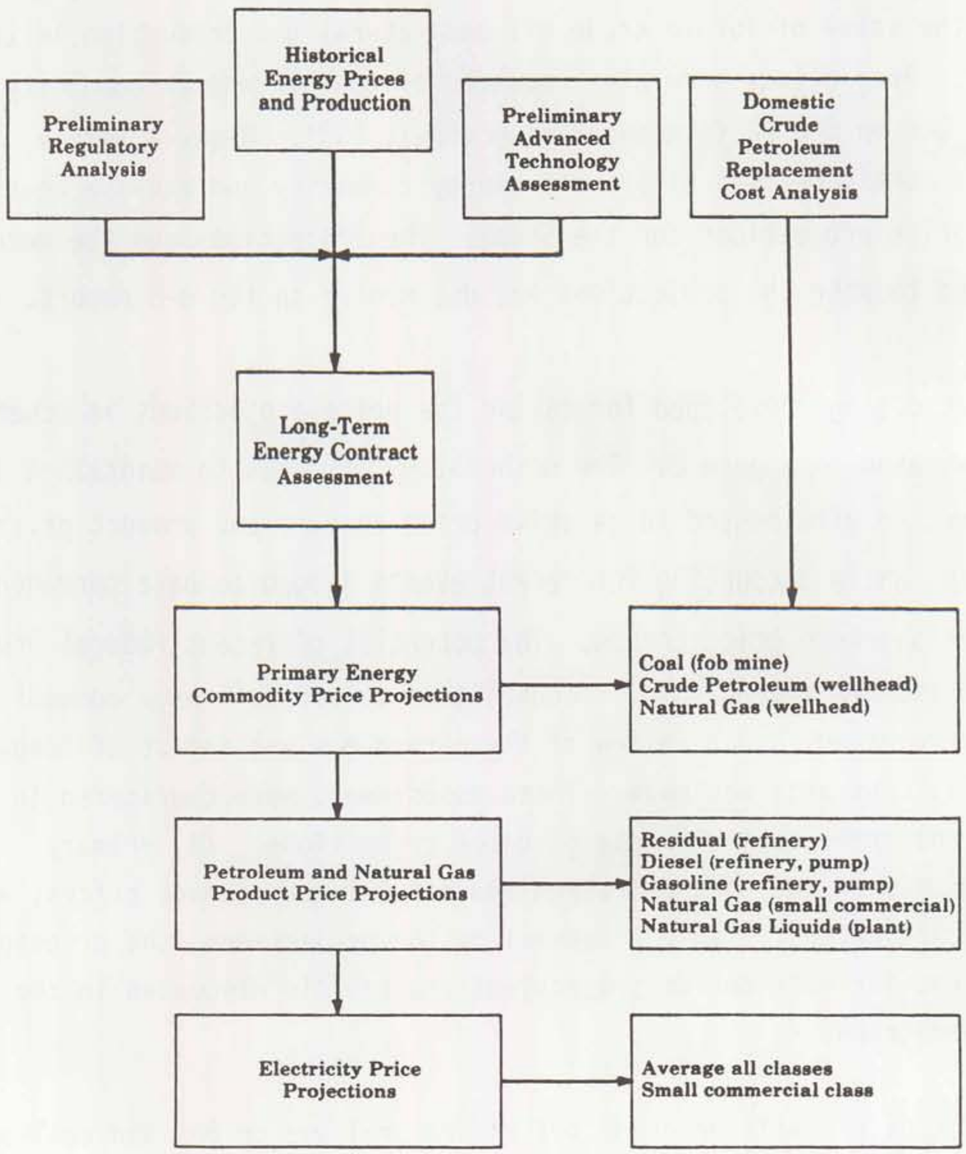
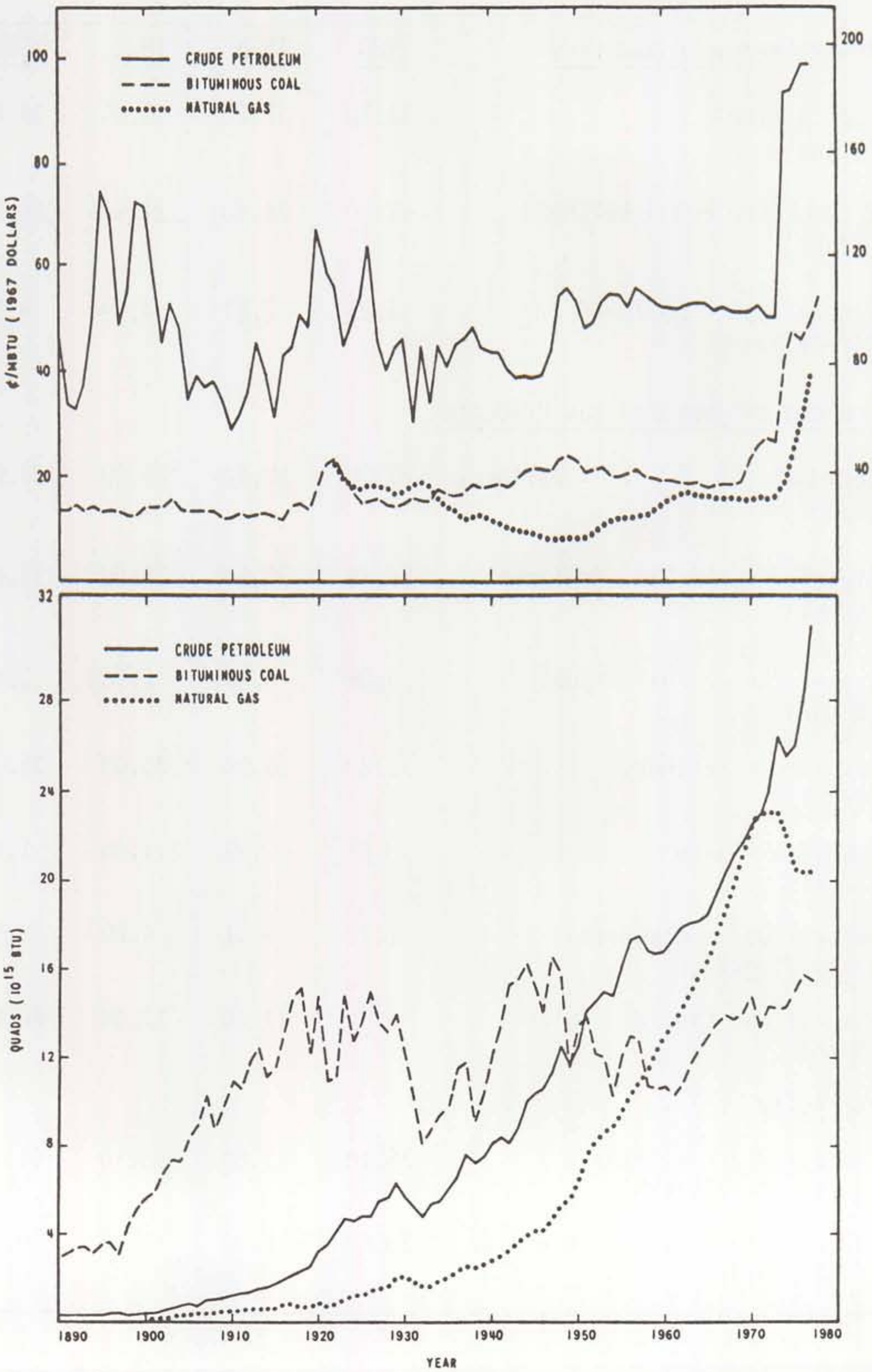


Table 1: PROJECTED REGIONAL PRICES OF PRIMARY AND END-USE ENERGY COMMODITIES (1977 DOLLARS)

	Year				
Primary Energy Commodities	1980	1985	1990	2000	2020
Coal - mine ($/ton)	11.10	11.80	12.00	14.00	17.40
Crude Petroleum - wellhead ($/bbl)	19.60	24.40	24.90	25.90	28.10
Natural Gas - wellhead ($/mcf)	1.23	2.81	4.39	4.56	4.95
Petroleum and Natural Gas Products					
Residual (No. 6) Oil - refinery ($/bbl)	23.20	28.42	29.00	30.10	32.40
Diesel (No. 2) Oil - refinery ($/bbl)	26.30	31.10	31.60	32.60	34.80
Diesel (No. 2) Oil - pump ($/gal)	0.86	0.97	0.98	1.01	1.06
Gasoline - refinery ($/bbl)	31.20	35.50	36.00	36.90	38.90
Gasoline - pump ($/gal)	0.89	0.99	1.00	1.02	1.06
Natural Gas - commercial class ($/mcf)	1.73	3.31	4.89	5.06	5.45
Natural Gas Liquids - plant ($/bbl)	6.81	13.10	19.30	20.00	21.50
Electricity					
Electricity - average all classes (mills/kWh)	35.10	41.60	48.10	61.10	67.60
Electricity - small commercial (mills/kWh)	39.50	46.80	54.30	68.60	76.50

FIGURE 3: NATIONAL PRIMARY ENERGY RESOURCE PRICE AND PRODUCTION



Petroleum and natural gas price projections were made based on an analysis of the historical price relationship between primary energy commodities and the various products. The analysis showed that the feedstock-product price relationship would best be approximated for the High Plains Region on a constant dollar per million Btu basis. The projections were then developed using the current (March 1980) price markups.

Electricity prices were projected based on projections of future generating capacity mix and the projections of input fuel prices. The projections assumed successful implementation of the Powerplant and Industrial Fuel Use Act of 1978 and the resultant impact of reduced natural gas fueled electricity generation in the Study area.

Estimates of other farm input prices were developed by Arthur D. Little, Inc. in conjunction with the state researchers, based in part upon an assessment of the effect of energy prices on energy related industries--notably fertilizer--and the market distorting effects of currently enforceable patents on important herbicides and pesticides.

An estimate of the prices at which crops can be sold is one of the most important factors to be incorporated into any farm enterprise model. Except for alfalfa, major field crops raised in the High Plains--cotton, wheat, corn, grain sorghum and soybeans--have a nationwide market, and local prices paid to farmers closely reflect the national price. Alfalfa is used in livestock production and demand is related to its nutritional and roughage value and the total demand for feed grains in the Region. To estimate crop prices, the General Contractor selected the NIRAP (National-Inter-regional Agricultural Projection) model [4]* developed by the U.S. Department of Agriculture**. National prices were then adjusted in each state to reflect differences based on transportation costs and local market conditions.

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* See Figure 1.

** Because USDA is prohibited by law from estimating cotton prices, Arthur D. Little researchers developed independent projections of cotton prices.

The NIRAP model projects commodity prices based upon observed historical relationships between supply and demand for various crops, including substitution between crops. The demand curve in a future year is projected based upon growth in U.S. population and per capita income and the demand for exports of farm commodities caused by economic growth and agricultural shortfalls in the rest of the world. Production is estimated based upon past trends in land use (with appropriate constraints) and projected increases in the productivity (i.e. crop yields) of farm land. The specific assumption used in projecting these supply and demand curves are discussed below. The crop prices projected over the forty-year study period generally show a slow rise in real terms.

The effect of changes in High Plains production on national crop prices and production was estimated using an iterative process between NIRAP and the state LP farm enterprise models. An initial estimate of national prices was made using the NIRAP model with estimates of total national production including production losses resulting from a decline in irrigated acreage in the High Plains. These prices were then provided to the state LP researchers, who refined estimates of production in the Baseline using these prices. Regional production totals for each crop derived from the state LP models were then substituted for the initial estimates for the High Plains Region which were included in national production in the original NIRAP estimates.

As the analysis moved sequentially through the alternative management strategies, the crop prices for each strategy (beginning with the Baseline) became the initial prices for analysis of the next succeeding strategy. The LP models were run to reflect the changes in water use and availability resulting from the policies included in the management strategy. Resulting changes in High Plains crop production were then entered into the NIRAP model, and revised prices and national production totals were calculated for each crop in each study year. The NIRAP model thus allowed for other regions to change production, if indicated, when High Plains production changes produced a change in national price. This new price became the final price for the management strategy, and the results of the LP models were recalculated using the final price. Where changes from the preceding strategy of less than one percent of national production were shown in the initial run of a management strategy, the NIRAP model was not used to calculate revised crop prices because only a minimal change in price, generally less than one to two percent, would occur. In this case, the initial crop prices and production totals for a strategy became the final production and price estimates, and the analysis moved on to calculation of the initial estimates of the production effects of the next strategy using the same set of crop prices.

To exercise the NIRAP crop pricing model, it is necessary to have estimates of aggregate national economic activity because domestic demand for food and fiber is determined by population and real per capita income. National economic activity estimates are also necessary for using state and regional input/output [I/O] models to project economic activity in the High Plains. For the High Plains study, the INFORUM forecasting service developed by Clopper Almon, Jr. was used for both purposes. INFORUM projects national input/output matrices including each significant industry sector through the study period (2020)[5]*. The picture presented by these projections is one of slow but real economic growth. Over the forty year period, the average rate of U.S. economic growth is faster than that experienced in the 1970's, but slower than the prolonged expansion from the end of World War II to 1970. Projections of real per capita income growth estimated by INFORUM are incorporated in the demand estimates of the NIRAP model. The export of agricultural commodities which INFORUM estimates as necessary to finance U.S. imports is similar in magnitude to the export demand estimates contained in the NIRAP model.

The results from the state farm enterprise (LP) models flow into state economic models which use the input/output (I/O) method to project future economic activity [6]*. Purchases by farmers of various inputs (fuel, farm machinery, fertilizers, etc.) provide demand for industries located inside and outside the state or region. Some of the crops produced are sold to other industries in the region--notably cattle feeding-- and the rest of the crop is exported outside the region or outside the Nation. Returns to land and management estimated in the LP models provide income to the farmer and possibly to others who own the land or have loaned money for the purchase of

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* See Figure 1.

the land. The rest of returns to land and management becomes a component of final consumer demand in the region.

Each state has constructed a set of transaction tables which display the interrelationship between different industry sectors and final demand. The states have determined what portion of the purchase and sales between industries occur within the Ogallala portion of the state, and which transactions occur across the Ogallala regional boundary. Using this information, the state I/O transaction tables show the trade relationships between industries and across the regional boundary for the base year (1977).

To estimate the regional economic impacts of a water management strategy over the forty year period of the study, the I/O transaction tables are first used to project overall economic activity and economic activity in each sector in the Baseline condition. The solution is reached by an iterative process which reflects the constraint imposed on economic activity by production in the primary resource sectors (agriculture and oil and gas production). Initially, a level of final demand is projected. This level is estimated based on the national economic growth projected in the INFORUM model and the changes which this would imply in regional economic activity. This is then tested against the amount of agricultural activity and oil and gas production which will occur in each study year under the management strategy. Final demand estimates are then revised until the requirements for regional agricultural production are consistent with the projections of agricultural output from the LP models. Final demand must also be adjusted to reflect income derived from projected energy production. Inputs required for this level of agricultural production are projected from estimates in the LP farm enterprise models of the amounts purchased by farmers from each industry.

Using this method, the activity in each economic sector in the Ogallala subregion of the state is projected. Constraints imposed by limits on agriculture and energy production are carried through the entire economy. Changes in relationship between economic sectors which occur as a result of technological changes projected in the INFORUM estimates are also incorporated in these models. Using historic relationships between output and employment in each industry, and projected levels of productivity growth (taken from national estimates in the INFORUM model) it is possible to predict total employment associated with the projected level of economic activity. Using traditional ratios between population and employment, total regional population is estimated. Wages per employee and income per capita can also be calculated from the results. Yields from the existing state and local tax structure in future years can also be estimated using observed ratios between different types of economic activity and revenue received from different taxes (sales, income, property, severance).

As succeeding water management strategies are analyzed, the changes in agricultural production and farm input requirements are worked through the entire economy by the use of a multiplier developed from the Baseline I/O production. Energy production is presumed to be independent of agricultural water management strategies. As farm production is increased or decreased by a particular water management strategy, the regional economy and agriculture-related sectors show changes which are a function of the raised or lowered constraint imposed by agricultural production levels.

The results of the state I/O projections of economic activity in the Ogallala portion of each state cannot simply be added to determine the volume of economic activity in the whole High Plains Region. The state I/O models generally have only two regions - the High Plains subregion of the state and the "rest of the world". A few may differentiate the rest of the state from the "rest of the world". However, activity in the Ogallala portion of another state is encompassed in the "rest of the world". Thus, purchase of feed grain from the Oklahoma panhandle by a Texas feedlot is not, in fact, a purchase outside the Ogallala. Therefore, it is necessary to build a regional model which avoids the inaccuracies of an accounting approach to determination of total regional economic activity.

In addition, state models vary somewhat in the construction of their transaction tables. The models do not have identical economic sectors. It is necessary to aggregate economic sectors from some states and disaggregate others in order to develop a standard regional transaction table. Using an approximation of trade flow from the location quotient approach, state results are corrected to adjust for discrepancies resulting from the treatment of intra-regional trade. Arthur D. Little, Inc. constructed this regional I/O model with three sectors, the northern High Plains (Nebraska, Colorado and Kansas portions of the Ogallala), the southern High Plains (New Mexico, Oklahoma, and Texas Ogallala), and "the rest of the world" [7]*. The "rest of the world" includes non-Ogallala portions of the six states, the rest of the U.S., and actual imports to and exports from the U.S. (including High Plains agricultural products which are shipped overseas). The High Plains was divided into two sectors for several reasons, including:

- ° Different climate and cropping patterns
- ° Different water supplies
- ° Dominance of the energy economy in the southern High Plains
- ° Existing regional trade flows

Data developed by each state I/O model is fed into the High Plains regional model after appropriate adjustments for sectoral differences and intra-regional trade flows. When the model is solved to balance final demand, agricultural production, and levels of growth in the "rest of the world" (from the INFORUM projections), the regional I/O model provides projections for the two subregions for each study year of the same critical economic variables projected in the state models, including:

- ° Output of each industrial sector
- ° Employment
- ° Total personal income
- ° Gross regional product (total value added, total sales)
- ° Population and per capita income

The differences in these values resulting from the raising or lowering of water-induced constraints on agricultural production in each management strategy are then calculated. The transaction table from each state which are fed into the regional model are adjusted using the multiplier developed in the Baseline I/O projections applied to changes in the farm production and income sectors which are indicated by each water management strategy.

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*See Figure 1.

CRITICAL SENSITIVITIES IN IMPACT ANALYSIS

The analytic methodology as a whole is sensitive to five critical factors subject to variation over the forty year period of the Study and not amenable to precise and deterministic calculation. These factors are:

- ° Water use efficiency
- ° Farm productivity increases (crop yields per acre)
- ° Energy prices
- ° Export demand
- ° National economic growth rate

The last two factors combine to determine the demand for food and fiber, and thus the price that will be paid for any given amount of a crop which is produced.

Although annual rates of change in each variable are relatively small, compounding effects over the 40 year Study period produce significant variation in total values by 2020. To test the sensitivity of the interacting models, we have reviewed the changes in model results which will occur in 2000 and 2020 if the rates of change in these factors are changed.

The importance of these factors was recognized by the researchers and reviewers from the Consulting Advisory Panel which reviewed the study while in progress. Experts who reviewed the assumptions and projections used in the study differed as to the appropriate estimates, and whether or not the Contractor's projections were too high or too low. The effects of variance in these critical factors are discussed below.

Water Use Efficiency

Each state assessed the applicability of various water saving technologies and the rate at which farmers within the state would adopt these new technologies. As a result, there are variations between states in water use for each crop based upon local soil and climate conditions, method of irrigation and projections of improved irrigation technology. In general, high energy prices are expected to push farmers rather quickly to improvement in irrigation efficiency.

Texas, for example, projected that average water use per acre would fall from 1.38 acre-feet in 1977 to 0.68 acre-feet in 1990 and 0.65 acre-feet in 2020. In much of the Texas High Plains, the Ogallala is relatively thin, but these efficiency improvements were sufficient to keep most irrigated land in production through the Study period. The sensitivity of the results to water use efficiency is shown in the following table, derived from a Texas Alternative Baseline scenario in which projected improvements in water use efficiency were cut approximately in half.

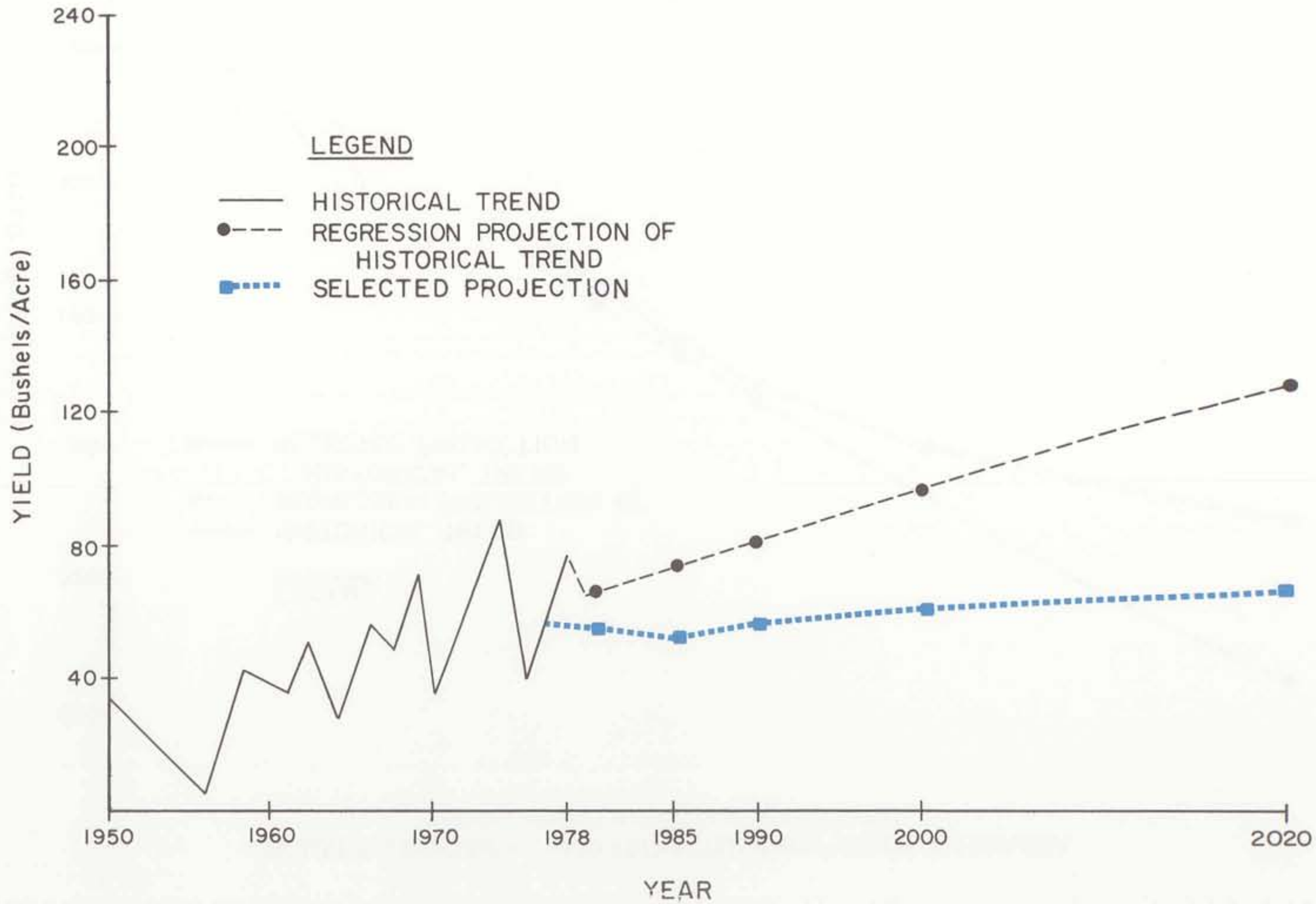
	Baseline		Baseline Alternative - 50% Less Efficiency	
Year	Average Water Use (acre-feet/acre)	Land in Irrigation (million acres)	Average Water Use (acre-feet/acre)	Land in Irrigation (million acres)
1977	1.38	6.1	1.38	6.1
1990	.68	-	-	-
2000	-	5.55	1.103	5.52
2020	.65	4.49	1.101	1.19

In general, the Texas Baseline projected farmers reaching higher levels of water use efficiency than any other state. Because the Aquifer is thin in much of the Texas High Plains the increase in annual withdrawal due to lower water use efficiencies has a magnified effect on land going out of production which might not be observed during the Study period in areas where the saturated thickness of the Ogallala is thicker, as it is in portions of Kansas and Nebraska. Nevertheless, it is clear that the future of irrigated agriculture is highly sensitive to the rate and extent at which farmers adopt new efficient irrigation techniques.

Agricultural Productivity

Some critics asked if it was reasonable to assume continued increases in crop yields per acre through 2020. Figures 4, 5, 6, 7, and 8 show actual and projected yield increases for key crops in Nebraska. Dryland and irrigated yields are plotted separately. These projections are consistent with those used in all six states. Note that the average annual increase in yield is

FIGURE 4: HISTORICAL AND PROJECTED CROP YIELDS, NEBRASKA SUBREGION FOUR—NONIRRIGATED CORN



SIX-STATE HIGH PLAINS OGALLALA AQUIFER REGIONAL RESOURCES STUDY

FIGURE 5: HISTORICAL AND PROJECTED CROP YIELDS, NEBRASKA SUBREGION FOUR—IRRIGATED CORN

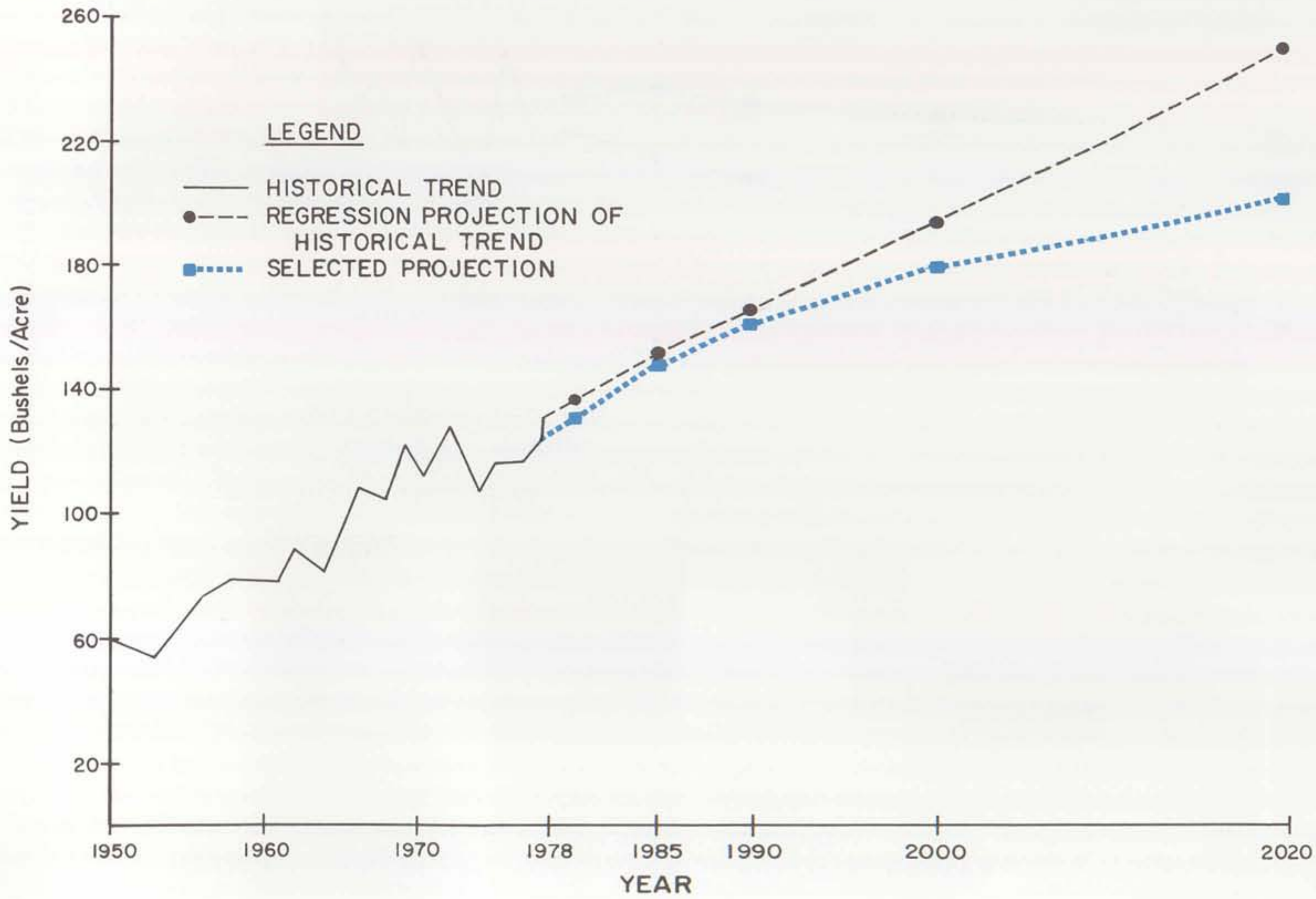


FIGURE 6: HISTORICAL AND PROJECTED CROP YIELDS, NEBRASKA SUBREGION FOUR—NONIRRIGATED GRAIN SORGHUM

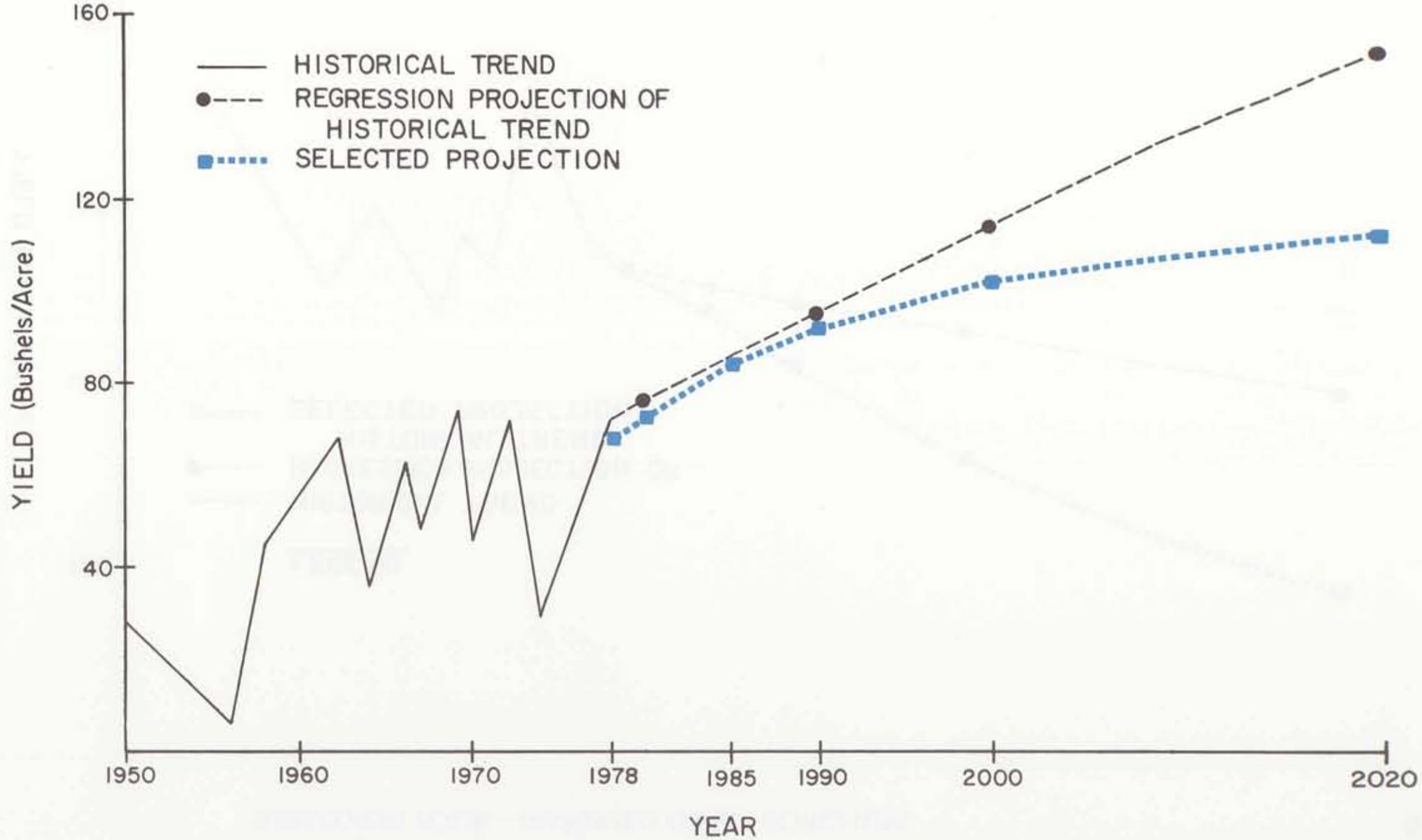


FIGURE 7: HISTORICAL AND PROJECTED CROP YIELDS, NEBRASKA SUBREGION FOUR—IRRIGATED GRAIN SORGHUM

SIX-STATE HIGH PLAINS OGALLALA AQUIFER REGIONAL RESOURCES STUDY

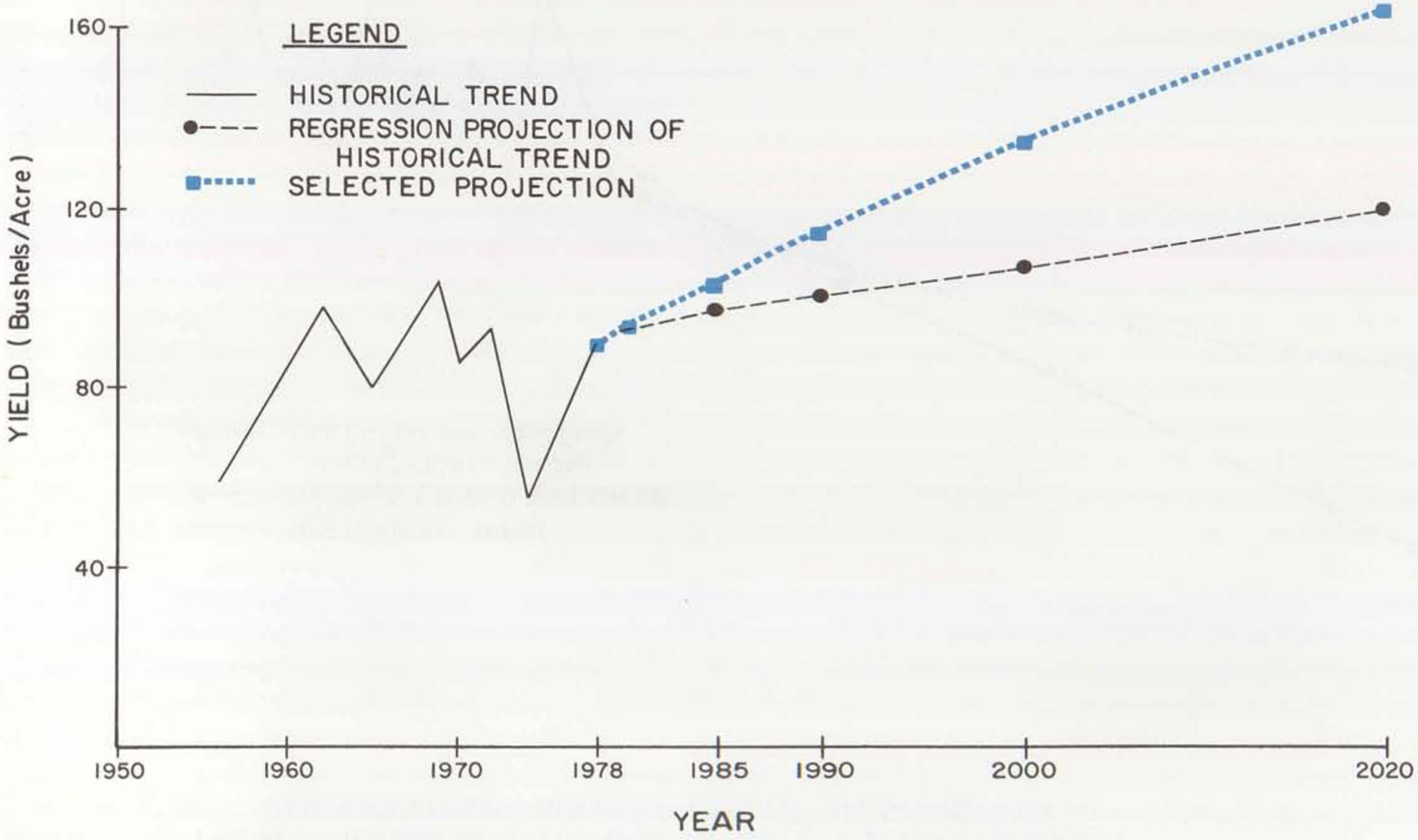
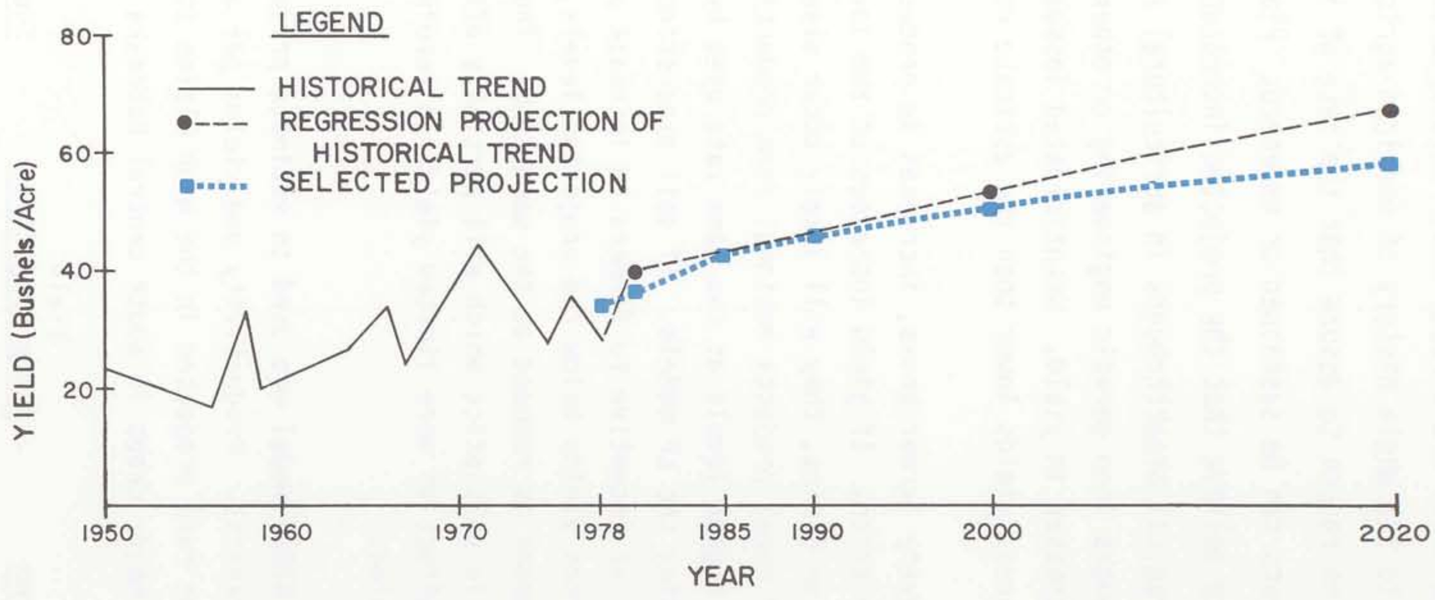


FIGURE 8: HISTORICAL AND PROJECTED CROP YIELDS, NEBRASKA SUBREGION FOUR—NONIRRIGATED WHEAT



below that experienced from 1950 to the start of the Study period. To assume no increase in yield would imply that agricultural research is abandoned or proves fruitless, and that farmers refuse to adopt new plant varieties and techniques which are already under development. Either result would be contrary to the whole history of American agriculture. On the other hand, there is no reason to assume that the rate of increase in yield over the last thirty years can be sustained or exceeded. Plant scientists consulted in each state believe that the projected increases in yield can be sustained without radical breakthroughs in agricultural research. Unanticipated breakthroughs from genetic engineering or other sources could cause more rapid increases in yield. Unanticipated losses in intrinsic soil fertility could depress yields lower than the estimate used in the Study.

As every farmer knows, increases in production have a compensating effect on price. If yield increases of the level used in the analysis occur in the High Plains, they will likely occur elsewhere in the U.S. as well. The NIRAP model projects national farm productivity (the supply curve) to shift to higher levels at the same rate used by state researchers in constructing the LP models. If soil exhaustion, poor agricultural research, or a lack of incentive to farmers to increase productivity (and yield per acre) forces yields below the projected levels, real crop prices must rise unless demand is reduced at the same time. Thus, the farmer will receive an increase in unit price which will partially offset lower total production, and the effect of more limited yields on returns to land and management will be moderated.

The NIRAP model was used to estimate price effects in a low productivity growth scenario. Productivity and yields per acre were assumed to grow at 75% of the rate projected in the High Plains Study. As a result, yield per acre for major crops in south central Nebraska in 2020 would be reduced as follows:

Crop	Yield Study Projection	Yield - Study - Low Band Sensitivity
Corn	202 bu/acre	177
Wheat		
Dryland	58 bu/acre	50
Irrigated	81 bu/acre	71
Sorghum	166 bu/acre	141

However, NIRAP projects a six to twelve percent increase in the real price of these crops if national productivity increases are held to this level. The effect on the total value of production for an acre of Nebraska land in 2020 is shown as follows:

Crop	Study Projection Price/bushel*	Study Projection Value/acre	Low Band Sensitivity Price/bushel	Low Band Sensitivity Value-acre
Corn	2.83	571	3.16	561
Wheat				
Dryland	3.23	187	3.56	180
Irrigated	3.23	263	3.56	253
Sorghum	2.44	404	2.72	384

Input costs per acre will be reduced somewhat if yield per acre is cut to these levels. As a result, High Plains farmers are likely to continue in production, although irrigation may be less attractive in some areas. Nationally, consumer prices will increase, and the additional production in the later years of the study attributable to water conservation or water imports will have a somewhat greater effect on crop prices and consumer prices because of the smaller national production base.

Because of the moderate nature of the projected productivity increases used in the analysis, and the compensating effect of reduced production on real crop prices, the projection does not appear to threaten the validity of the analytic conclusions presented.

Energy Prices

Some of the more notable reactions to study projections occurred in the area of energy pricing. Energy prices affect the study in two ways; they affect the farmer's costs of production, and they determine the health of the energy related sectors of the economy in those High Plains states which have reserves of oil and gas. If real energy prices rise more rapidly than projected, they will increase the farmer's costs of production and decrease returns to land and management. If they rise enough, they could force

* State level prices determined from NIRAP, actual amounts vary between states by as much as 10 percent.

farmers to stop pumping available ground water and return to dryland production or allow land to revert to grazing. Some subregions do show a brief decline in irrigation around 1990 because of the costs of pumping from the Ogallala. Land is soon restored to irrigated production as productivity and real crop price increases expand the farmer's returns to land and management more rapidly than the energy price induced increase in the cost of pumping.

When viewed from the perspective of the High Plains region as a whole, a more rapid rise in energy prices may expand the regional economy by an amount which more than offsets any decline in farm production or returns to land and management. This is particularly true in the southern three states of the Ogallala. In the Texas High Plains, the energy producing sectors have expanded from ten percent of the regional economy in 1970 to sixteen percent of a substantially larger economy in 1979. Despite an increase in production, agriculture fell from ten percent to six percent of the regional economy in the same period. The rapid increase in domestic oil and gas prices since the 1974 Arab oil embargo accounts for this shift. Energy is likely to dominate the economy of the Southern High Plains through much of the study period, until recoverable reserves of oil and gas begin to play out. This occurs despite the use of energy price forecasts which some reviewers have called conservative. The energy sector analysis predicts that such exhaustion will occur toward the end of the study period, with a consequent decline in employment and royalty income in the oil and gas sector.

To test the sensitivity of projections of farm production and returns to land and management, Black and Veatch developed a higher band of energy price increases for the purpose of sensitivity analysis. The energy prices used in the results reported in this analysis were projected to increase 0.4 percent per year after deregulation brings domestic oil and gas prices to world levels. The high band sensitivity analysis estimated real energy prices to increase at 2.530 percent per year after reaching the world price level. The high band sensitivity was selected to reach the highest level possible without altering the structure of the NIRAP model. Based upon experience of the last two years, such a sustained rate of increase would reduce economic growth and induce fuel switching and conservation to such an extent that this higher rate of real increase would very likely not be maintained throughout the Study period under any conditions.

Some states ran the LP models using the higher real energy prices. A full summary of these analyses is contained in study element B-8. The results show that the increase in energy related costs (pumping, fertilizer, tractor fuel) eats into the farmer's profits. Returns to land and management are reduced. In practice, this would undoubtedly reduce the rate of increase in the sale price of farm acreage. There is some shifting between crops but irrigated land generally remains in production. While energy prices eat into farm profits, returns to land and management are still positive because the value of production continues to increase. A representative example is shown for New Mexico in 2020: some cotton land shifts into sorghum, and returns to land and management are reduced $20 million for the crops there.

Crop	Energy Prices Used in High Plains Analysis Total Prod.	RLM	High Band Energy Prices Total Prod.	RLM
Cotton	25,923,000 lbs.	$7,630,000	10,124,000 lbs.	$1,646,000
Wheat	19,686,000 bu.	$47,373,000	19,497,000 bu.	$33,621,000
Sorghum	2,027,000 bu.	$8,711,000	2,988,000 bu.	$8,298,000
Alfalfa	Unchanged			
		$63.7 million		$43.6 million

Those who believed that higher energy prices in the long run might force irrigated land back to dryland production have reasoned from the experience of the past few years. Real oil and gas prices have increased 200 percent and 300 percent respectively over the 1974-80 period. Average yields per acre increase only very gradually as new cultivation practices are adopted. Prices increase slowly in the long run with rising population and income. Short-term prices will show sharp fluctuations because of weather-induced variations in supply. Over the forty year period, a gradual increase in energy prices should be offset by higher crop prices and yields so that the total crop production projected in the Baseline will be relatively unaffected. Quantum leaps in energy prices over the very short term (one to five years) can distort these results.

In general, the results shown for different strategies will not be greatly changed by higher energy prices, although larger price increases could bring about improved water use efficiencies in the Baseline in early years similar to those projected for Management Strategy One. Higher energy prices alone could provide the incentive for more rapid adoption of new irrigation techniques. A second effect of higher energy prices is not actually shown in the analysis, but would likely occur. Because imported water must be pumped up much greater distances than ground water from the Ogallala, the operating costs of a water import scheme would increase more rapidly than the farmer's costs for pumping ground water if energy prices increase at a higher rate.

Export Demand

In 1978, more than 25 percent of U.S. farm production was exported. Agricultural exports have risen at a rapid rate in the 1970's, far faster than in previous years, and have become a major source of foreign exchange. The historical trend in exports of major High Plains crops (wheat, grain sorghum, cotton) are shown in Figures 9, 10, and 11. These figures also show the projected export increases used in the NIRAP model to calculate future price increases. Also shown on the graphs are extrapolations of the trends in exports from historical experience in the thirty year period from 1950-1979, and for the decade of the 1970's. For cotton and sorghum, the projected increases from 1980 to 2020 lie between the two ranges of historical experience; exports are not expected to expand as rapidly as in the past decade, but will grow more rapidly than they did in the period ending in 1970. Only wheat shows an increase in exports faster than historical trends (there was little difference between the two historical periods for wheat).

Export demand is critically dependent on three factors:

- ° Shortfalls in domestic production in importing countries.
- ° Effective demand from these countries, based upon growing real per capita income.
- ° Foreign trade policies.

FIGURE 9: HISTORICAL AND PROJECTED COMMODITY EXPORTS—U.S. COTTON EXPORTS

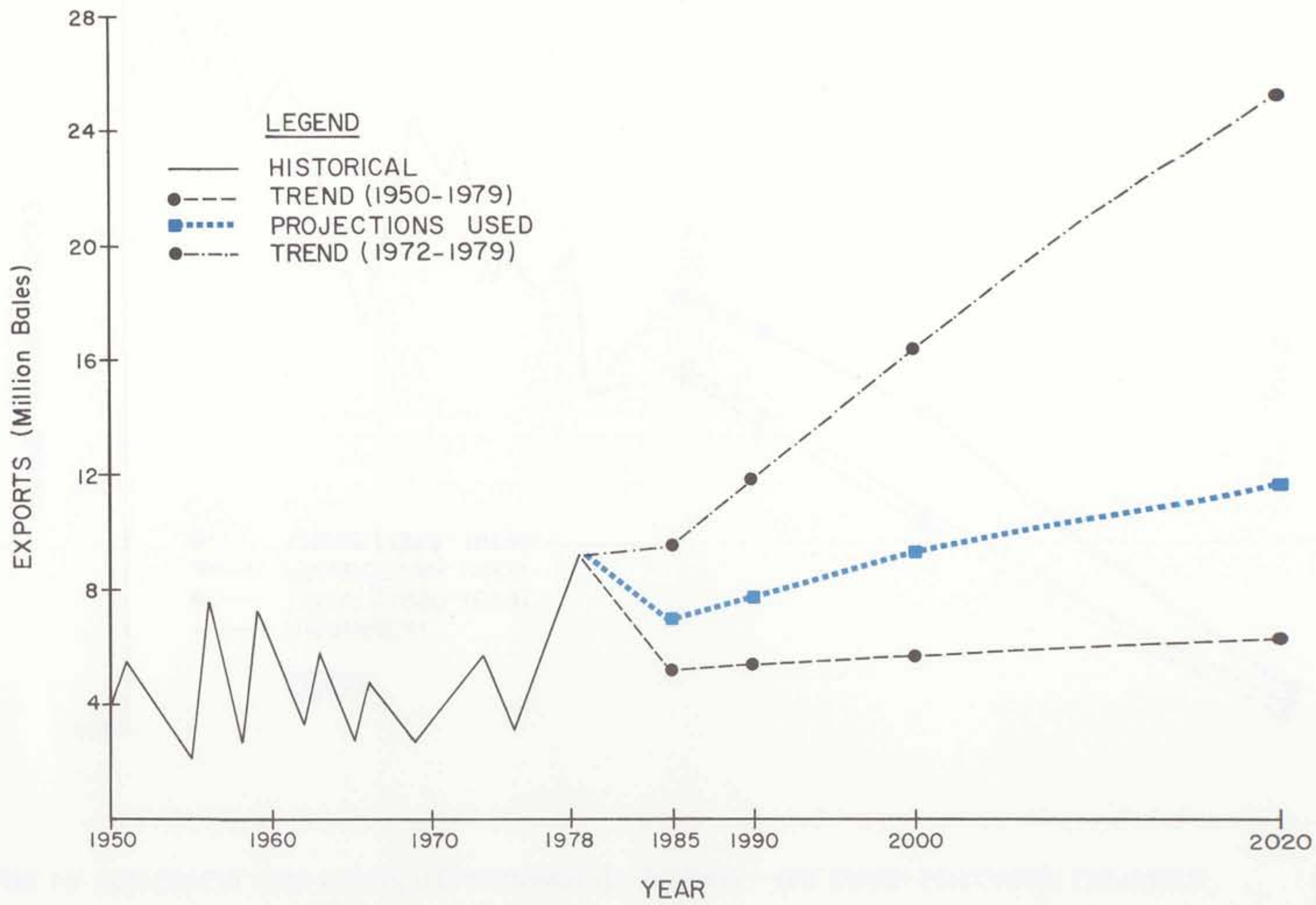


FIGURE 10: HISTORICAL AND PROJECTED COMMODITY EXPORTS—U.S. GRAIN SORGHUM EXPORTS

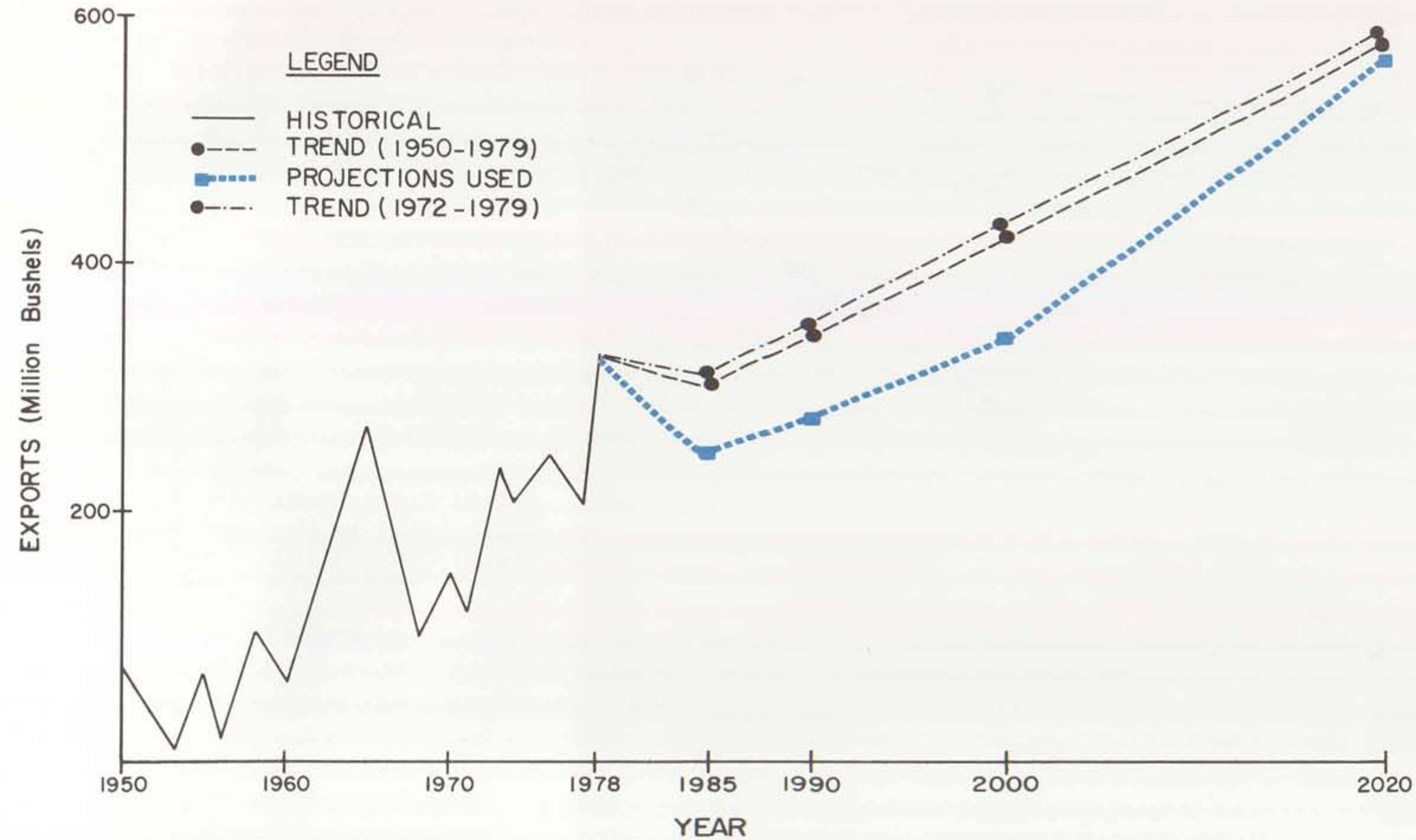
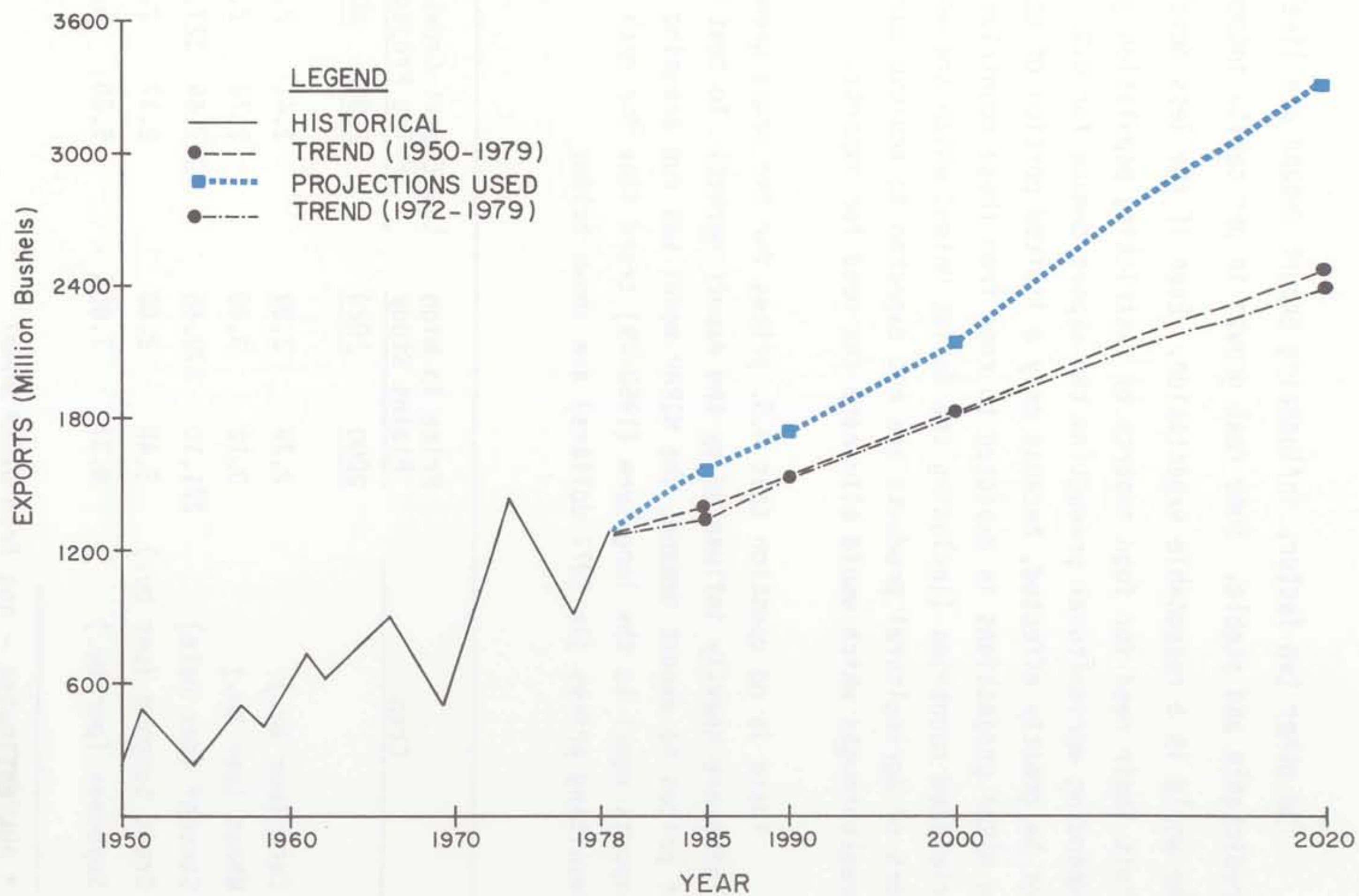


FIGURE 11: HISTORICAL AND PROJECTED COMMODITY EXPORTS—U.S. WHEAT EXPORTS



The most elusive of these three variables is trade policy. Export projections used in the study assume relatively free trade in agricultural commodities, with no politically induced embargoes of agricultural exports to a major U.S. customer.

The other two factors influencing export demand are likely to be more predictable and stable. Some real growth in per capita income throughout the world is a reasonable expectation. Even if the less developed countries limit their need for food imports by restricting population growth and expanding agricultural production the export demand for U.S. products would not be greatly effected, because only a limited portion of export demand used in NIRAP projections is expected to come from these countries. The industrialized countries (including the Soviet Union) which are now major importers of agricultural products are not expected to achieve agricultural breakthroughs which would eliminate the need for imports.

There is no question that U.S. prices for the crops grown on the High Plains are heavily influenced by the export market. To test the sensitivity of prices to export demand, the NIRAP model was run assuming a growth in exports equal to the long-term (1950-79) trend line for each commodity. The resulting prices (in 1977 dollars) are shown below:

Crop	Price in High Plains Study		Low Export Growth Scenario Price Projections	
	2000	2020	2000	2020
Corn (per bu.)	2.76	2.89	2.41	2.25
Wheat (per bu.)	3.12	3.40	2.78	2.76
Cotton* (per bale)	271.10	279.65	227.44	227.44
Grain Sorghum (per bu.)	2.48	2.60	2.17	2.03
Soybeans (per bu.)	6.37	7.05	5.26	5.09

* ADL estimates - not from NIRAP model

Economic Growth

The rate of national economic growth used in the study has two important effects:

- ° As a major component in the determination of domestic demand for agricultural products.
- ° As a determinant of the volume of economic activity in the Region.

The economic growth scenario used in the INFORUM projections which govern the state and regional I/O models and the NIRAP demand estimates shows a moderate rate of growth. Like agricultural exports and productivity increases, the estimates of national economic growth fall between the trend from the end of World War II to 1970, and that observed in the 1970's. Real gross national product is expected to increase 3.3 percent per year from 1979 to 1985, 2.4 percent per year from 1985 to 1990, and 2.0 percent per year thereafter. A breakthrough in economic growth is always possible, but seems unlikely based upon current experience in mature industrial societies constrained by the increasing scarcity of fuel and raw materials. Similarly, a prolonged period of zero growth or depression (negative growth) is possible, but should be prevented by political and economic adjustments. More important for the results of the High Plains study, the crucial measures of economic impact are just that, measures of <u>impact</u>, or the difference between key economic variables for different water management strategies. Changes in the level of national economic growth will strongly affect the volume of the regional economy and the absolute size of these indicators; however, because a consistent national growth scenario is used for all management strategies, the relative <u>differences</u> in regional economic indicators resulting from water-related changes in agricultural production should not be affected.

Much more important to the study results is the effect of national economic growth on the demand for agricultural products. Population is the other component (in addition to economic growth) in determining domestic demand food. The projected 2020 U.S. population of approximately 280 million is consistent with current fertility trends which are well established in all western industrial democracies and seem unlikely to change.

Changes in real per capita incomes resulting from economic growth do strongly affect food demand, particularly the demand for meat, which in turn determines the demand for feed grains grown on the High Plains. The economic growth projections provided from INFORUM for use in the NIRAP model are conservative and constitute a "most likely" scenario for the U.S. economy over the next forty years. If growth is more rapid than expected, we could expect increased demand for meat to drive up feed grain prices above the levels used in the anlaysis. If the economy stagnates completely, real crop prices would increase more slowly than projected, unless there were a compensating reduction in agricultural productivity.

Although crop prices are determined by a combination of foreign (export) and domestic demand, these effects are combined in the agricultural prices provided for the LP farm enterprise models. Figures 12 and 13 show the trends in real crop prices from 1958 to 1978, and the crop price increases projected by NIRAP for use in the High Plains study. The projections moderate large year to year variations resulting from weather related production shifts or sharp increases in export demand. The projected long-term trend is for slow growth in crop prices below the actual 1958-78 increase.

The reduction in crop prices of 19-28 percent* in 2020 produced by the "low export" scenario could also have resulted from lower domestic demand coupled with a level of exports between the "low export" scenario and that used in the actual analysis. Depressed domestic demand for food and restricted food exports could result in no increase in real crop price. Several states tested the LP models using lower crop prices. A typical result is shown for Oklahoma in the Baseline case, with estimates of constant real prices.

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* Original projection for 2020, four major crops vs. the 2020 projections for a "low export" scenario.

FIGURE 12: HISTORICAL AND PROJECTED COTTON PRICES—1977 DOLLARS

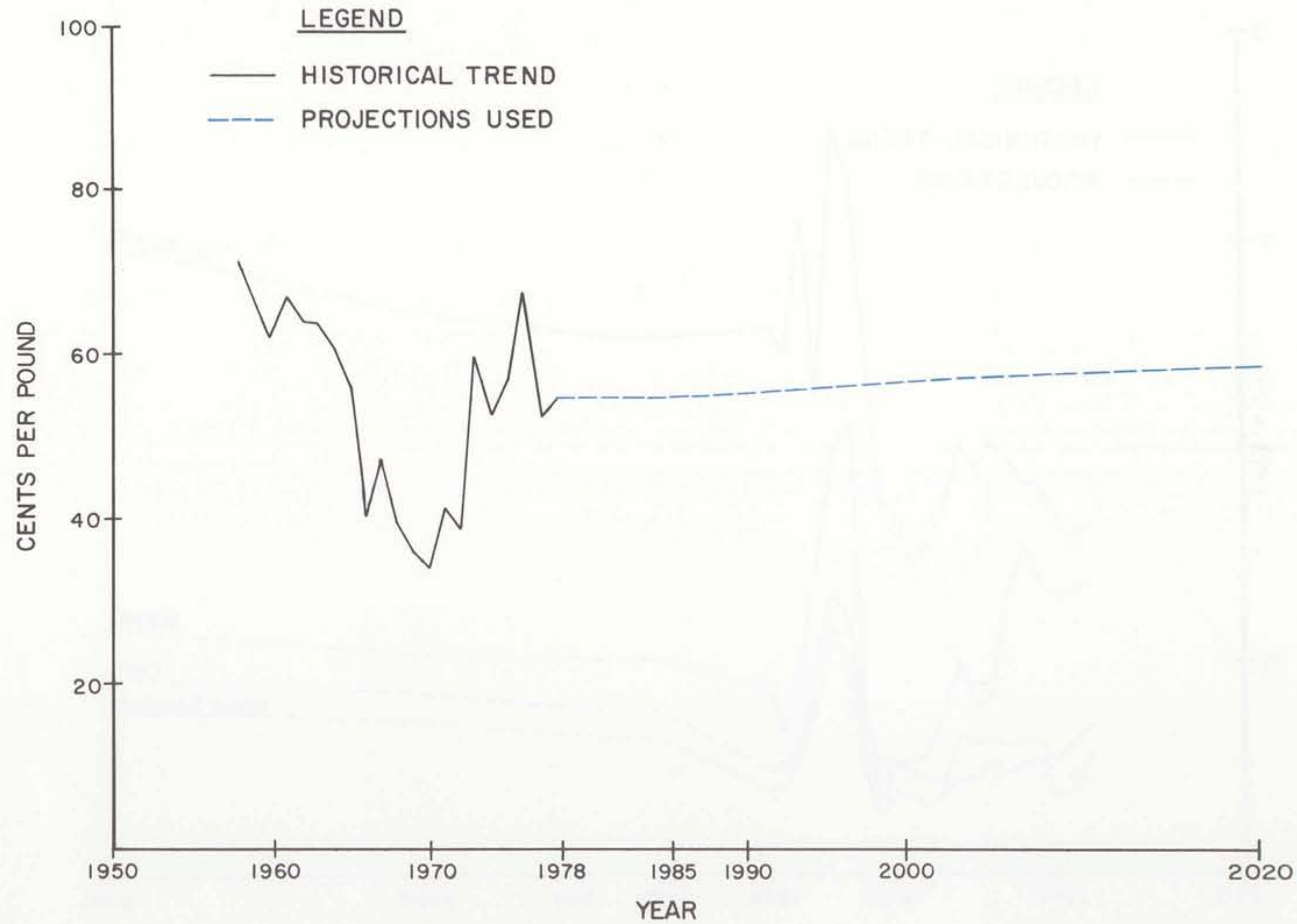
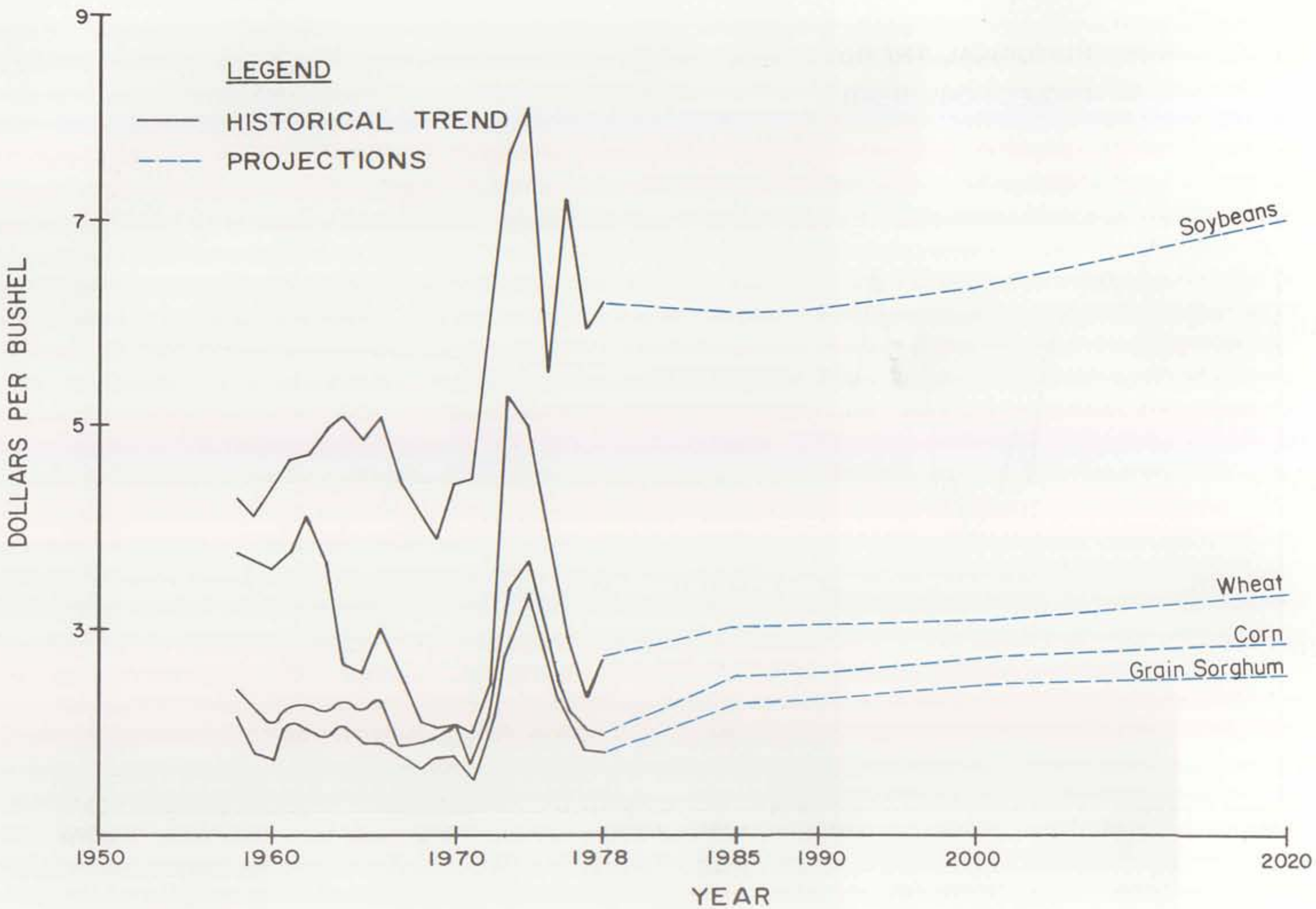


FIGURE 13: HISTORICAL AND PROJECTED CROP PRICES (NIRAP Projections—1977 Dollars)



Crop	2020 Price Estimates Used in High Plains Analysis: Price/ Unit* ($/Unit)	Total Production (Million Bu)	Irrigated Acres (1000 Acs)	RLM (mil $)	Low Price Estimates: Price/ Unit ($/Unit)	Total Production (Million Bu)	Irrigated Acres** (1000 Acs)	RLM (mil $)
Corn	3.09	14.7	80	--	2.23	2.3	18	--
Wheat	3.40	42.7	47	--	2.67	36.1	46	--
Sorghum	2.63	32.0	206	--	1.95	19.3	31	--
Alfalfa	74.16	296.0***	47	--	53.52	64.0***	11	--
Total	--		430	69	--	--	133	20

* State level prices determined using NIRAP projections. Prices vary between states by as much as 10 percent.

** Harvested Acres

*** Thousand Tons

These price changes have more of an effect on the profitability of High Plains farming than variations in productivity or energy prices. While a major variation from projected productivity would greatly effect production and commodity and consumer prices, such a change would have a lesser effect on returns to land and management and the total value of regional production, and thus will have a smaller effect on the regional economy than these lower price increases. If prices fall low enough, they can make irrigated farming, or even dryland farming, unprofitable on the High Plains. The number of acres in production could then be effected significantly. Export demand is the most fluid and unpredictable variable in determining whether these lower prices will actually occur.

The attractiveness of different water management strategies could also be affected by a shift in prices. Depressed levels of returns to land and management mean that farmer's have a smaller amount available to pay for water, and thus can pay a smaller fraction of the costs of an import scheme. If implemented, the import scheme could increase production and depress national prices and returns to land and management still further in the "low price" scenarios.

In conclusion, we can say that the results of this study are most sensitive to the commodity price projections used, and these, in turn, are most sensitive to the demand for export of U.S. farm products. The assumptions used to estimate export demand are reasonable if relatively free trade in agricultural commodities continues and there is no major shift in the relationship between domestic production and demand for food in the countries which are currently major customers for U.S. farm products. A collapse in the export market would have a more significant effect on the economy of the High Plains Region than likey variations from the projected levels of energy price, agricultural productivity, or domestic economic growth used in this study.

Alternative Future Events

A second set of sensitivity analyses was performed to assess the effect of specific events occurring in the Region. Using the regional input/output model, the impacts of three significant changes from the High Plains conditions used in the analysis of water management strategies were assessed. This "what if" analysis projected significant economic indicators for scenarios of drought, enhanced irrigation, and an expanded energy sector.

Drought

The analysis of management strategies in Chapters Five and Six was based on annual average rainfall. In this sensitivity analysis projections were made of a year in which yields fell as a result of insufficient rainfall to levels based on previous drought year experience.

Yield reductions based on examination of statistics for the worst year in ten indicate a loss of 25 percent for dryland production of wheat, sorghum and cotton in comparison to Baseline projections. Irrigated corn yields fall by 7 percent, while irrigated sorghum is down 16 percent and cotton down 25 percent.

As a result of these drought induced yield reductions, the value added by farm production in the North falls 10 percent below Baseline in each

Study year. In the South, losses from Baseline projections are down from 17 percent to 18 percent of value added by farm production through the Study period. For the Region as a whole, the drought year loss averages 12 percent*.

While production is cut by drought even when imported irrigation water is available under Strategy Five-A, water importation keeps farm returns substantially above Baseline levels in the North. Production is 10 percent above the Baseline in 2000 and 14 percent in 2020. In 2020, the improvement from a drought year without water imports totals 27 percent for value added in the farm sector.

In the South, the effect of imports in cutting drought losses is somewhat more moderate. Nevertheless, farm value added in 2020 in a drought year is 3 percent less than Baseline levels, and 18 percent above the levels which would occur in a drought year without water imports. For the Region as a whole in 2020, water imports change a drought year loss of 12 percent from the Baseline into a gain of more than 10 percent above Baseline.

These drought year gains from water importation work through the economy in a significant way. Table 2 shows net changes from expected Baseline values for total value added (all sectors), household income, and employment. By 2020, water imports shift a drought year economic loss** of 2.8 percent from Baseline into a gain of 2.7 percent, a net favorable saving of 5.5 percent or almost $2.7 billion (1977 dollars). The swing in household income is comparable, from a loss of 2.7 percent of Baseline to a gain of 2.2 percent above Baseline in 2020. The stabilizing effect on employment is even more notable, particularly in the northern Ogallala, which is more dependent on agricultural production. In 2020, a drought year employment loss of 2.7 percent could be converted to a 3.8 percent gain in employment for the Region as a whole with the import strategy in place.

* These changes do not reflect compensating short-term adjustments in crop prices which may occur if production losses on the High Plains are not offset by higher than normal production in other regions of the country.

** Total value added in the Region.

Table 2: SENSITIVITY ANALYSIS: DROUGHT YEAR EFFECTS OF WATER IMPORTATION, COMPARISON TO BASELINE PROJECTIONS FOR 2000 and 2020*

	North		South		Total Region	
	Drought Year No Imports	Drought Year MS-5A Imports	Drought Year No Imports	Drought Year MS-5A Imports	Drought Year No Imports	Drought Year MS-5A Imports
Total Value Added (All Sectors)						
2000	-4.2	4.2	-1.2	-0.5	-2.2	1.1
2020	-4.5	6.6	-1.6	0.1	-2.8	2.7
Total Household Income						
2000	-3.9	4.1	-1.8	-0.8	-2.5	0.9
2020	-4.0	5.9	-1.9	0.1	-2.7	2.2
Employment						
2000	-3.9	5.4	-1.4	-0.4	-2.4	1.9
2020	-4.5	8.3	-1.5	0.6	-2.7	3.8

*All values are percentage changes from Baseline Projections (normal precipitation). Total value added and household incomes are compared using real (1977) dollar values.

Enhanced Irrigation

In this analysis, the amounts of water to be imported to each state in the years 2000 and 2020 were projected to be double the amounts provided under Management Strategy Five-A. This additional water was projected to be used to convert dryland acreage to irrigated acreage. Cropping patterns on the newly irrigated land would be the same as those on lands irrigated with imported water in Strategy Five-A. This scenario provides an idea of the economic expansion that might occur if irrigation were expanded beyond historic levels. No attempt was made to define the total need for such additional water in individual states, or the relative value of the additional amounts.

Results of the analysis indicate that increasing water imports, with the resultant conversion of dryland to irrigation would have favorable effects which carry through the entire regional economy. The effects shown here using the regional I/O model somewhat overstate the net favorable effects because no downward revision in crop prices was made to reflect the continuing increase in national production which would follow from expanded irrigation on the High Plains. Table 3 shows changes from the Baseline for significant economic variables for Strategy Five-A, and for this sensitivity analysis which doubles the amount of water imported under Strategy Five-A. The trend is favorable, but increases the Region's dependence on agriculture: in the North, farm production rises approximately $2 billion above Strategy Five-A to 42 percent of total value added in the economy in 2020. For the Region, farm value added is up approximately $2.4 billion in 2020 over the level that is achieved under Strategy Five-A*, while total value added increases $3.3 billion above Five-A and $5.3 billion above Baseline.

I/O Energy Price Sensitivities

Because of the dependence of the economy in the southern Ogallala area on the energy sector, higher prices that would increase the value added in the economy were examined. Table 4 shows the increases in the energy sector

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* Without compensating adjustments in crop price

Table 3: SENSITIVITY ANALYSIS: ADDITIONAL WATER IMPACTS - DOUBLING OF WATER IMPORTATION UNDER MS-5A IN COMPARISON TO BASELINE PROJECTIONS FOR 2000 AND 2020*

	North		South		Total Region	
	MS-5A	2x MS-5A	MS-5A	2x MS-5A	MS-5A	2x MS-5A
Value Added Farm Sector						
2000	12.5	40.1	8.0	15.9	11.4	33.9
2020	16.3	46.8	14.5	31.5	15.9	43.3
Value Added All Sectors						
2000	5.4	16.4	0.7	1.4	3.5	6.4
2020	7.8	21.6	1.6	3.6	5.9	10.8
Household Income						
2000	5.0	15.7	0.9	2.1	2.3	6.7
2020	6.9	19.6	1.8	4.3	3.6	9.8
Employment						
2000	10.0	18.3	1.2	2.3	4.7	8.6
2020	13.7	25.2	2.3	4.4	7.0	12.9

* All values are percentage changes from Baseline in year shown--crop prices unchanged from levels projected for MS-5A. Values calculated using millions of 1977 dollars for Value Added and Household Income.

Table 4: SENSITIVITY ANALYSIS - HIGHER ENERGY PRICE*

	Value Added (Millions of 1977 $)	Percent Increase from Value In High Plains Analysis (Baseline)
North		
1985	1,496	22.3%
1990	1,754	24.4%
2000	1,189	22.7%
2020	537	20.4%
South		
1985	14,171	25.6%
1990	19,022	27.2%
2000	15,803	27.7%
2020	6,013	27.8%
Region		
1985	15,667	25.2%
1990	20,776	27.0%
2000	16,992	27.4%
2020	6,550	27.1%

* For oil and gas production and petroleum refining only.

prices used in this sensitivity analysis. Both the value added for the energy sector and the percentage increase from the energy sector activity used in the study projections are shown. These changes are based on an approximately 20 percent increase in oil and gas prices and in oil and gas revenues above projected levels.* The analysis shows the effects of growth in the energy production sectors and the decrease in value added in energy consuming sectors due to higher energy prices.

If higher energy prices were to occur, total value added in the Region increased by $2.66 billion (6.9 percent) in 2000 and $1.34 billion (2.9 percent) in 2020 (when compared to the Baseline). The 20 percent energy revenue increase boosts the regional economy by approximately 7 percent in 2000 and 3 percent in 2020. Total household income was up 3.3 percent above Baseline in 2000 and 2.0 percent in 2020. Employment would rise by 7,000 jobs in 2000, and only 5,000 in 2020--with most of these gains occurring in the southern part of the Region. While state and local government revenues would be approximately $47 million greater in 2020 with this energy outlook, the decline in revenue from 2000 to 2020 is even steeper (5.5 percent in the Baseline vs. 12.6 percent in the enhanced energy scenario).

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* This analysis accounts for both increased oil and gas revenues and the resulting increase in income to the petroleum, refining, natural gas distribution and utility sectors. No increase in production is projected here.

APPENDIX "B"

BASELINE AND ALTERNATIVE
MANAGEMENT STRATEGY RESULTS

TABLES

BASELINE

Table V-1: BASELINE ANNUAL WATER USE RATES, BY STATE, SUBREGION AND REGION
(1000's Acre-Feet per Year)*

State	Year	Ann. Water Use
Colorado	1977	1,150
	1985	1,075
	1990	1,005
	2000	965
	2020	655
	△77-2020	-495
	%△	-43%
Kansas	1977	3,280
	1985	2,590
	1990	1,540
	2000	1,015
	2020	825
	△77-2020	-2,455
	%△	-75%
Nebraska	1977	7,835
	1985	10,220
	1990	11,355
	2000	12,965
	2020	14,800
	△77-2020	6,965
	%△	89%
New Mexico	1977	965
	1985	1,000
	1990	940
	2000	825
	2020	555
	△77-2020	-410
	%△	-42%
Oklahoma	1977	670
	1985	755
	1990	605
	2000	795
	2020	820
	△77-2020	150
	%△	22%
Texas	1977	8,240
	1985	5,605
	1990	3,820
	2000	3,575
	2020	3,235
	△77-2020	-5,005
	%△	-61%

Subregions/Region

Subregion/Region	Year	Water Use
North	1977	12,265
	1985	13,885
	1990	13,900
	2000	14,945
	2020	16,280
	△77-2020	4,015
	%△	33%
South	1977	9,875
	1985	7,360
	1990	5,365
	2000	5,195
	2020	4,610
	△77-2020	-5,265
	%△	-53%
Total Region	1977	22,140
	1985	21,245
	1990	19,265
	2000	20,140
	2020	20,890
	△77-2020	-1,250
	%△	-6%

* All values rounded to nearest 5,000 acre-feet.

Table V-1.1: BASELINE - OGALLALA WATER REMAINING IN STORAGE BY STATE, SUBREGION AND REGIONAL TOTALS (Millions of Acre-Feet)*

State	Year	Water Reserves
Colorado	1977	93.6
	1985	89.4
	1990	86.3
	2000	80.8
	2020	70.6
	Δ77-2020	-23.0
	%Δ	-25%
Kansas	1977	244.4
	1985	220.8
	1990	209.3
	2000	197.0
	2020	182.5
	Δ77-2020	-61.9
	%Δ	-25%
Nebraska	1977	2,335.0
	1985	2,274.0
	1990	2,226.0
	2000	2,098.0
	2020	1,956.0
	Δ77-2020	-379.0
	%Δ	-16%
New Mexico	1977	23.8
	1985	20.5
	1990	18.4
	2000	14.8
	2020	9.5
	Δ77-2020	-14.3
	%Δ	-60%
Oklahoma	1977	59.9
	1985	54.6
	1990	51.4
	2000	44.5
	2020	29.0
	Δ77-2020	-30.9
	%Δ	-52%
Texas	1977	283.7
	1985	220.1
	1990	197.0
	2000	158.3
	2020	87.2
	Δ77-2020	-196.5
	%Δ	-69%

Subregions/Region

North

Year	Water
1977	2,673.0
1985	2,584.2
1990	2,521.6
2000	2,375.8
2020	2,209.1
Δ77-2020	-463.9
%Δ	-17%

South

Year	Water
1977	367.4
1985	295.2
1990	266.8
2000	217.6
2020	125.7
Δ77-2020	-241.7
%Δ	-66%

Total Region

Year	Water
1977	3,040.4
1985	2,879.4
1990	2,788.4
2000	2,593.4
2020	2,334.8
Δ77-2020	-705.6
%Δ	-23%

* All values rounded to nearest 0.1 MAF

Table V-2: BASELINE CROPLAND ACREAGE - IRRIGATED AND DRYLAND, BY STATE, SUBREGION AND REGIONAL TOTALS (1000's Acres)*

State	Year	Base Acreages (1000's) Irr.	Dry	Total
Colorado	1977	600	1,685	2,285
	1985	560	1,710	2,270
	1990	530	1,735	2,265
	2000	500	1,750	2,250
	2020	365	1,815	2,180
	△77-2020	-235	130	-105
	%△	-41%	8%	-5%
Kansas	1977	2,180	3,965	6,145
	1985	1,785	5,010	6,795
	1990	1,090	5,470	6,560
	2000	760	6,045	6,805
	2020	580	6,450	7,030
	△77-2020	-1,600	2,485	885
	%△	-73%	63%	14%
Nebraska	1977	4,700	5,945	10,645
	1985	6,750	4,940	11,690
	1990	7,860	4,400	12,260
	2000	9,820	3,660	13,480
	2020	11,465	3,560	15,025
	△77-2020	6,765	-2,385	4,380
	%△	144%	-40%	41%
New Mexico	1977	440	505	945
	1985	445	510	955
	1990	415	545	960
	2000	355	615	970
	2020	245	730	975
	△77-2020	-195	225	30
	%△	-44%	45%	3%
Oklahoma	1977	395	1,355	1,750
	1985	510	1,240	1,750
	1990	345	1,410	1,755
	2000	415	1,340	1,755
	2020	450	1,305	1,755
	△77-2020	55	-50	5
	%△	14%	-4%	0.3%
Texas	1977	5,970	4,815	10,785
	1985	5,920	5,035	10,955
	1990	5,595	5,150	10,745
	2000	5,500	5,195	10,695
	2020	4,940	5,690	10,630
	△77-2020	-1,030	875	-155
	%△	-17%	18%	-1%

Subregions/Region

North

Year	Irr.	Dry	Total
1977	7,480	11,595	19,075
1985	9,095	11,660	20,755
1990	9,480	11,605	21,085
2000	11,080	11,455	22,535
2020	12,410	11,825	24,235
△77-2020	4,930	230	5,160
%△	66%	2%	27%

South

Year	Irr.	Dry	Total
1977	6,805	6,675	13,480
1985	6,875	6,785	13,660
1990	6,355	7,105	13,460
2000	6,270	7,150	13,420
2020	5,635	7,725	13,360
△77-2020	-1,170	1,050	-120
%△	-17%	16%	-1%

Total Region

Year	Irr.	Dry	Total
1977	14,285	18,270	32,555
1985	15,970	18,445	34,415
1990	15,835	18,710	34,545
2000	17,350	18,605	35,955
2020	18,045	19,550	37,595
△77-2020	3,760	1,280	5,040
%△	26%	7%	15%

* Rounded to the nearest 5,000 acres.

Table V-2.1: BASELINE CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE*

State	Year	Wheat (Mil.Bu.)	Corn (Mil.Bu.)	Sorghum (Mil.Bu)	Soybeans (Mil.Bu.)	Alfalfa (1000 T.)	Cotton (1000 Bales)
Colorado	1977	36.9	56.4	6.5	0.0	180	0
	1985	39.0	50.7	6.2	0.0	174	0
	1990	43.1	63.9	4.0	0.0	179	0
	2000	49.1	68.9	3.8	0.0	174	0
	2020	64.5	49.0	2.6	0.0	137	0
	△77-2020	27.6	-7.4	-3.9	0.0	-43	0
	%△	75%	-13%	-60%	--	-24%	--
Kansas	1977	127.8	91.3	37.4	0.6	999	0
	1985	149.1	96.9	52.3	1.3	1,073	0
	1990	167.6	39.0	58.9	2.5	1,286	0
	2000	199.2	24.4	70.8	4.2	1,370	0
	2020	248.2	27.5	95.1	5.2	1,367	0
	△77-2020	120.4	-63.8	57.7	4.6	368	0
	%△	94%	-70%	154%	767%	37%	--
Nebraska	1977	79.7	539.0	108.0	8.5	3,315	0
	1985	74.5	829.0	120.1	41.1	3,590	0
	1990	67.6	976.5	121.5	67.2	3,697	0
	2000	57.1	1,286.6	122.0	107.6	3,718	0
	2020	60.8	1,622.0	153.3	161.3	3,795	0
	△77-2020	-18.9	1,083.0	45.3	152.7	480	0
	%△	-24%	201%	42%	1,798%	14%	--
New Mexico	1977	9.4	12.4	11.8	0.0	243	42
	1985	9.7	18.2	15.2	0.0	396	45
	1990	13.3	19.5	13.7	0.0	438	41
	2000	15.4	17.3	13.0	0.0	496	48
	2020	20.6	13.4	6.6	0.0	492	55
	△77-2020	11.2	1.0	-5.2	0.0	249	13
	%△	119%	8%	-44%	--	102%	31%
Oklahoma	1977	22.8	6.4	14.5	0.0	230	0
	1985	27.9	8.4	19.5	0.0	279	0
	1990	26.4	9.9	21.8	0.0	285	0
	2000	31.6	12.1	27.6	0.0	290	0
	2020	42.7	14.7	32.0	0.0	296	0
	△77-2020	19.9	8.3	17.5	0.0	66	0
	%△	87%	130%	121%	--	29%	--
Texas	1977	50.9	157.3	121.4	5.4	546	2,916
	1985	35.4	88.7	140.0	23.0	583	4,290
	1990	32.1	43.1	140.8	26.9	625	4,900
	2000	32.2	19.6	180.6	7.9	677	5,699
	2020	35.0	11.4	191.0	3.4	846	5,887
	△77-2020	-15.9	-145.9	69.6	-2.0	300	2,971
	%△	-31%	-93%	57%	-37%	55%	102%

* Wheat, corn, sorghum and soybeans rounded to nearest 0.1 million bushels. Alfalfa values rounded to nearest 1,000 tons and cotton to nearest 1,000 bales.

Table V-2.2: BASELINE CROP PRODUCTION BY SIX MAJOR CROPS, BY SUBREGION AND REGIONAL TOTALS*

State	Year	Wheat (Mil.Bu.)	Corn (Mil.Bu.)	Sorghum (Mil.Bu)	Soybeans (Mil.Bu.)	Alfalfa (Mil.T.)	Cotton (1000 Bales)
North	1977	244.4	686.6	151.9	9.2	4.5	0
	1985	262.6	986.6	178.6	42.4	4.8	0
	1990	278.4	1,079.4	184.4	69.6	5.2	0
	2000	305.4	1,379.9	196.6	111.8	5.3	0
	2020	373.5	1,698.6	251.0	166.4	5.3	0
	△77-2020	129.1	1,012.0	99.1	157.2	0.8	0
	%△	53%	147%	65%	1,709%	18%	--
South	1977	83.1	176.1	147.8	5.4	1.0	2,958
	1985	73.0	115.3	174.7	23.0	1.3	4,335
	1990	71.7	72.6	176.4	26.9	1.3	4,941
	2000	79.2	49.1	221.2	7.9	1.5	5,747
	2020	98.3	39.6	229.6	3.4	1.6	5,942
	△77-2020	15.2	-136.5	81.8	-2.0	0.6	2,984
	%△	18%	-78%	55%	-37%	60%	101%
Total Region	1977	327.5	862.7	299.7	14.6	5.5	2,958
	1985	335.6	1,101.8	353.3	65.4	6.1	4,335
	1990	350.1	1,152.0	360.8	96.6	6.5	4,941
	2000	384.6	1,429.0	417.8	119.7	6.7	5,747
	2020	471.8	1,738.2	480.7	169.8	6.9	5,942
	△77-2020	144.3	875.5	181.0	155.2	1.4	2,984
	%△	44%	101%	60%	1,063%	25%	101%

* Wheat, corn, sorghum and soybeans values rounded to nearest 0.1 million bushels; alfalfa to nearest 0.1 million tons ; and cotton to nearest 1,000 bales.

Table V-3: BASELINE - VALUE OF AGRICULTURAL PRODUCTION, BY STATE, SUBREGION AND REGIONAL TOTAL (Millions 1977 Dollars)*

State	Year	Value
Colorado	1977	275
	1985	315
	1990	340
	2000	385
	2020	395
	△77-2020	120
	%△	44%
Kansas	1977	655
	1985	860
	1990	805
	2000	935
	2020	1,260
	△77-2020	605
	%△	92%
Nebraska	1977	1,680
	1985	2,935
	1990	3,495
	2000	4,765
	2020	6,455
	△77-2020	4,775
	%△	284%
New Mexico	1977	125
	1985	185
	1990	195
	2000	210
	2020	220
	△77-2020	95
	%△	76%
Oklahoma	1977	130
	1985	190
	1990	195
	2000	245
	2020	325
	△77-2020	195
	%△	150%
Texas	1977	1,705
	1985	2,290
	1990	2,380
	2000	2,635
	2020	2,835
	△77-2020	1,130
	%△	66%

Subregions/Region

North

Year	Value
1977	2,610
1985	4,110
1990	4,640
2000	6,090
2020	8,110
△77-2020	5,500
%△	211%

South

Year	Value
1977	1,960
1985	2,660
1990	2,770
2000	3,095
2020	3,385
△77-2020	1,425
%△	73%

Total Region

Year	Value
1977	4,570
1985	6,770
1990	7,410
2000	9,185
2020	11,495
△77-2020	6,925
%△	151%

* All values rounded to the nearest five million. Values at subregional and regional levels may not be additive from state totals due to rounding.

Table V-4: BASELINE - RETURNS TO LAND AND MANAGEMENT FROM AGRICULTURAL PRODUCTION, BY STATE, SUBREGION AND REGIONAL TOTAL (Millions 1977 Dollars)*

State	Year	Returns
Colorado	1977	90
	1985	95
	1990	90
	2000	120
	2020	160
	Δ77-2020	70
	%Δ	78%
Kansas	1977	210
	1985	315
	1990	380
	2000	550
	2020	855
	Δ77-2020	645
	%Δ	307%
Nebraska	1977	555
	1985	1,150
	1990	1,305
	2000	2,030
	2020	2,975
	Δ77-2020	2,420
	%Δ	436%
New Mexico	1977	25
	1985	60
	1990	65
	2000	90
	2020	115
	Δ77-2020	90
	%Δ	360%
Oklahoma	1977	30
	1985	40
	1990	30
	2000	50
	2020	70
	Δ77-2020	40
	%Δ	133%
Texas	1977	145
	1985	320
	1990	435
	2000	565
	2020	735
	Δ77-2020	590
	%Δ	407%

Subregions/Region

North

Year	Returns
1977	850
1985	1,555
1990	1,775
2000	2,700
2020	3,990
Δ77-2020	3,140
%Δ	369%

South

Year	Returns
1977	200
1985	420
1990	530
2000	700
2020	920
Δ77-2020	720
%Δ	360%

Total Region

Year	Returns
1977	1,050
1985	1,975
1990	2,305
2000	3,405
2020	4,910
Δ77-2020	3,860
%Δ	368%

* All values rounded to nearest $5 million. Subregional and regional values may not be additive from state totals due to rounding.

Table V-5: BASELINE REGIONAL ECONOMY - TOTAL VALUE ADDED, ALL SECTORS BY SUBREGION AND REGIONAL TOTALS (Millions 1977 Dollars)*

Year	North	South	Total Region
1977	7,047 (32.8%)**	14,406 (67.2%)**	21,453
1985	10,869	21,429	32,298
1990	11,957	26,643	38,600
2000	14,753	29,826	44,579
2020	19,636 (39.9%)**	29,540 (60.1%)**	49,176
△77-2020	12,589	15,134	27,723
% △	179%	105%	129%

* All values rounded to nearest $1 million. Regional totals may not be additive from subregional values due to rounding.

** Percentage of Total Regional Economy for Period

Table V-6: BASELINE REGIONAL ECONOMY - VALUE ADDED, BY AGRICULTURAL RELATED SECTORS BY SUBREGION AND REGIONAL TOTALS (Millions 1977 Dollars)*

Year	North		South		Total Region	
	Value	(Percent)**	Value	(Percent)**	Value	(Percent)**
1977	2,573	(36.5)	1,669	(11.6)	4,242	(19.8)
1985	4,302	(39.6)	2,135	(10.0)	6,437	(19.9)
1990	4,747	(39.7)	2,282	(8.6)	7,029	(18.2)
2000	6,310	(42.8)	3,042	(10.2)	9,352	(21.0)
2020	8,914	(45.4)	3,908	(13.2)	12,822	(26.1)
△77-2020	6,341		2,239		8,580	
% △	246%		134%		202%	

* All values rounded to nearest $1 million.

** Percentage of Total Value Added, all sectors, by Subregion and Region attributable to agriculturally related sectors (farm production, feedlots, agricultural processing and agricultural support sectors).

Table V-7: BASELINE REGIONAL ECONOMY - EMPLOYMENT AND TOTAL HOUSEHOLD INCOME, BY SUBREGION AND REGIONAL TOTALS (Employment in 1,000's Full Time Jobs; Income in Millions 1977 Dollars)*

Year	North		South		Total Region	
	Employment	Income	Employment	Income	Employment	Income
1977	444.2 (44.1%)**	4,909 (39.3%)**	563.6 (55.9%)**	7,575 (60.7%)**	1,007.8	12,484
1985	538.8	7,059	656.7	11,160	1,195.5	18,219
1990	533.3	7,718	703.3	14,165	1,236.6	21,883
2000	537.0	9,739	794.6	18,815	1,331.6	28,554
2020	554.7 (41.1%)**	13,356 (36.2%)**	778.4 (58.9%)**	23,557 (63.8%)**	1,333.2	36,913
Δ77-2020	110.5	8,447	214.8	15,982	325.4	24,429
% Δ	25%	172%	38%	211%	32%	196%

* Employment totals rounded to nearest 0.1 thousand full time job equivalents; Income values rounded to nearest $1 million. Regional values may not be additive from Subregional totals due to rounding.

** Percentage of Total Regional Employment or Income for 1977 and 2020.

Table V-8: BASELINE REGIONAL ECONOMY - POPULATION PROJECTIONS, BY SUBREGION AND REGIONAL TOTALS (1,000's of Persons)*

Year	North	South	Total Region
1977	903 (41.6%)**	1,268 (58.4%)**	2,171
1985	1,093	1,484	2,577
1990	1,084	1,595	2,679
2000	1,091	1,811	2,902
2020	1,128 (38.7%)**	1,787 (61.3%)**	2,915
$\triangle$77-2020	225	519	744
%$\triangle$	25%	41%	34%

* All values rounded to nearest thousand persons.

** Percentage of Total Regional Population for 1977 and 2020.

Table V-9: BASELINE REGIONAL ECONOMY - AVERAGE PER CAPITA INCOME*, BY SUBREGION AND REGIONAL TOTALS (1977 Dollars)**

Year	North	South	Total Region
1977	$ 5,436	$ 5,974	$ 5,750
1985	6,458	7,520	7,070
1990	7,120	8,881	8,168
2000	8,927	10,389	9,839
2020	11,840	13,182	12,663
△77-2020	$ 6,404	$ 7,208	$ 6,913
%△	118%	121%	120%

* Average Per Capita Income is Total Household Income divided by Population.

** All values rounded to nearest $1.

Table V-10: BASELINE REGIONAL ECONOMY - STATE AND LOCAL GOVERNMENT REVENUE PROJECTIONS, BY SUBREGION AND REGIONAL TOTALS (Millions 1977 Dollars)*

Year	North	South	Total Region
1977	308.4	564.6	872.9
1985	498.3	728.0	1,226.3
1990	539.2	977.5	1,516.7
2000	634.9	840.0	1,474.9
2020	846.1	547.7	1,393.8
$\triangle$77-2020	537.7	-16.9	520.9
%$\triangle$	174%	-3%	60%

* Assumes continuation of existing tax structures. All values rounded to nearest $0.1 million. Data for High Plains Study Region only.

Table V-11: BASELINE - ENERGY PRODUCTION PROJECTIONS FOR THE HIGH PLAINS STUDY REGION, 1985 TO 2020

	1985	1990	2000	2020	Cumulative 1980 - 2020
Crude Oil Production (Millions of Barrels)					
Conventional Recovery	393.5	306.0	227.5	24.0	9,540
Gas Flooding Recovery	40.5	85.5	297.5	31.5	5,700
Chemical Flooding Recovery	0.2	1.2	3.5	0.4	67
Total	434.2	392.7	528.5	55.9	15,307
Marketed Natural Gas Production (Billions of Cubic Feet)					
Associated (Casinghead)	630	526	602	61	19,304
Nonassociated (Dry)	2,463	1,904	1,093	360	56,331
Total	3,093	2,430	1,695	421	75,635
Electricity					
Generating Capacity (MW)	8,774	10,550	15,471	22,672	--
Energy Production (GWh)	34,523	41,592	62,118	91,168	--

Table V-12: BASELINE - WATER CONSUMPTION ASSOCIATED WITH ENERGY PRODUCTION IN THE HIGH PLAINS STUDY REGION, 1985 TO 2020

	1985	1990	2000	2020	Cumulative 1980 - 2020
Directly Associated Water Consumption (Thousands of Acre-Feet)					
Conventional Oil Production	48.2	42.9	39.5	5.7	1,387
Enhanced Oil Production	5.6	13.3	45.2	4.9	864
Electric Energy Production	69.0	83.2	124.2	182.3	4,913
Subtotal	122.8	139.4	208.9	192.9	7,164
Indirectly Associated Water Consumption (Thousands of Acre-Feet)					
Petroleum Refining	16.7	16.7	16.7	7.2	585
Natural Gas Liquids Processing	9.9	7.8	5.4	1.3	239
Subtotal	26.6	24.5	22.1	8.5	824
Total Associated Water Consumption (Thousands of Acre-Feet)	149.4	163.9	231.0	201.4	7,988

Table V-13: BASELINE - EMPLOYMENT ASSOCIATED WITH ENERGY PRODUCTION IN THE HIGH PLAINS STUDY REGION, 1985 TO 2020

	1985	1990	2000	2020
Directly Associated Employment (Thousands)				
Oil and Gas Extraction	80.5	86.7	91.0	26.4
Enhanced Oil Recovery (Incremental)	.9	2.1	7.6	1.4
Electric Energy Production	3.0	3.3	4.2	6.2
Subtotal	84.4	92.1	102.8	34.0
Indirectly Associated Employment (Thousands)				
Crude Oil Refining and Oil Products Manufacturing	3.8	3.8	3.8	1.6
Crude Oil and Natural Gas Field Equipment Manufacturing	5.6	6.1	7.2	1.2
Energy Transportation	10.7	10.1	10.8	8.3
Subtotal	20.1	20.0	21.8	11.1
Total Associated Employment	104.5	112.1	124.6	45.1

Table V-14: BASELINE - INCOME ASSOCIATED WITH ENERGY PRODUCTION IN THE HIGH PLAINS STUDY REGION, 1985 TO 2020

	1985	1990	2000	2020
Directly Associated Income (Millions of 1977 Dollars)				
Wages and Salaries, Oil and Gas Production	1,532	1,777	2,069	619
Proprietors' Income, Oil and Gas Production	459	533	621	186
Royalty Payments, Local Private Leases	1,346	1,623	2,295	258
Wages and Salaries, Electric Energy Production	48	56	78	139
Subtotal	3,385	3,989	5,063	1,202
Indirectly Associated Income (Millions of 1977 Dollars)				
Earnings, Crude Oil Refining and Oil Products Manufacturing	103	104	108	46
Earnings, Crude Oil and Natural Gas Field Equipment Manufacturing	101	117	153	30
Earnings, Energy Transportation	210	203	234	196
Subtotal	414	424	495	272
Total Associated Income (Millions of 1977 Dollars)	3,799	4,413	5,558	1,474

Note: "Earnings" includes wages and salaries, proprietors' income, and other labor income.

MANAGEMENT STRATEGY ONE

(MS-1)

Table VI-1: MANAGEMENT STRATEGY ONE (MS-1) - ANNUAL WATER USE RATES BY STATE, SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE FOR 1977 to 2020 (1000 Acre-Feet per Year)*

State	Year	MS-1	Change**	(%)
Colorado	1977	1,150	--	--
	1985	1,075	--	--
	1990	1,060	55	(5.5)
	2000	970	5	(0.5)
	2020	785	130	(19.8)
	△77-2020	-365	130	(25.5)
	%△	-32%		
Kansas	1977	3,280	--	--
	1985	2,425	-165	(-6.4)
	1990	1,650	110	(7.1)
	2000	2,170	1,155	(113.8)
	2020	1,540	715	(86.7)
	△77-2020	-1,740	715	(29.0)
	%△	-52%		
Nebraska	1977	7,835	--	--
	1985	9,330	-890	(-8.7)
	1990	10,250	-1,105	(-9.7)
	2000	12,720	-245	(-1.9)
	2020	14,885	85	(0.6)
	△77-2020	7,050	85	(1.2)
	%△	90%		
New Mexico	1977	965	--	--
	1985	970	-30	(-3.0)
	1990	890	-50	(-5.3)
	2000	740	-85	(-10.3)
	2020	560	5	(0.9)
	△77-2020	-405	5	(2.5)
	%△	-42%		
Oklahoma	1977	670	--	--
	1985	710	-45	(-6.0)
	1990	535	-70	(-11.6)
	2000	645	-150	(-18.9)
	2020	600	-220	(-26.8)
	△77-2020	-70	-220	(-146.7)
	%△	-10%		
Texas	1977	8,240	--	--
	1985	4,490	-1,115	(-19.9)
	1990	3,770	-50	(-1.3)
	2000	3,395	-180	(-5.0)
	2020	2,935	-300	(-9.3)
	△77-2020	-5,305	-300	(-6.1)
	%△	-64%		

Subregions/Region

North

Year	MS-1	Change**	(%)
1977	12,265	--	--
1985	12,830	-1,055	(-7.6)
1990	12,960	-940	(-6.8)
2000	15,860	1,115	(6.1)
2020	17,210	930	(5.7)
△77-2020	4,945	930	(23.2)
%△	40%		

South

Year	MS-1	Change**	(%)
1977	9,875	--	--
1985	6,170	-1,190	(-16.2)
1990	5,195	-170	(-3.2)
2000	4,780	-415	(-8.0)
2020	4,095	-515	(-11.2)
△77-2020	-5,780	-515	(-9.8)
%△	-59%		

Total Region

Year	MS-1	Change**	(%)
1977	22,140	--	--
1985	19,000	-2,245	(-10.6)
1990	18,155	-1,110	(-5.8)
2000	20,640	500	(2.5)
2020	21,305	415	(2.0)
△77-2020	-835	415	(33.2)
%△	-4%		

* All values rounded to nearest 5 thousand acre-feet. Subregional and Regional values may not be additive from state totals due to rounding. Dashes indicate no change from Baseline.

** Change from Baseline projections in absolute and percent values.

Table VI-1.1: MANAGEMENT STRATEGY ONE (MS-1) - OGALLALA WATER REMAINING IN STORAGE BY STATE, SUBREGION AND REGIONAL TOTALS, WITH COMPARISONS TO BASELINE PROJECTIONS (Millions of Acre-Feet)*

State	Year	MS-1 Water Reserves	Change**	(%)
Colorado	1977	93.6	--	--
	1985	89.4	--	--
	1990	86.3	--	--
	2000	80.6	-0.7	(-0.9)
	2020	69.8	-0.8	(-1.0)
	Δ77-2020	-23.8	0.8	(3.5)
	%Δ	-25%		
Kansas	1977	244.4	--	--
	1985	220.7	-0.1	--
	1990	210.1	0.8	(0.4)
	2000	196.7	-0.3	(-0.2)
	2020	159.5	-23.0	(-12.6)
	Δ77-2020	-84.9	23.0	(37.2)
	%	-35%		
Nebraska	1977	2,335.0	--	--
	1985	2,277.6	3.6	(0.2)
	1990	2,232.4	6.4	(0.3)
	2000	2,105.8	7.8	(0.4)
	2020	1,963.7	7.7	(0.4)
	Δ77-2020	-371.3	-7.7	(-2.0)
	%Δ	-16%		
New Mexico	1977	23.8	--	--
	1985	20.6	0.1	(0.5)
	1990	18.6	0.2	(1.1)
	2000	15.5	0.7	(4.7)
	2020	10.1	0.6	(6.3)
	Δ77-2020	-13.7	-0.6	(-4.9)
	%Δ	-58%		
Oklahoma	1977	59.9	--	--
	1985	54.8	0.2	(0.4)
	1990	51.8	0.4	(0.8)
	2000	45.6	1.1	(2.5)
	2020	32.4	3.4	(11.7)
	Δ77-2020	-27.5	-3.4	(-11.0)
	%Δ	-46%		
Texas	1977	283.7	--	--
	1985	224.6	4.5	(2.0)
	1990	201.6	4.6	(2.3)
	2000	163.8	5.5	(3.5)
	2020	96.9	9.7	(10.0)
	Δ77-2020	-186.8	-9.7	(-4.9)
	%Δ	-66%		

Subregions/Region

North

Year	MS-1 Water Reserves	Change**	(%)
1977	2,673.0	--	--
1985	2,587.7	3.5	(0.1)
1990	2,528.8	7.2	(0.3)
2000	2,382.6	6.8	(0.3)
2020	2,193.0	-16.1	(-0.7)
Δ77-2020	-480.0	16.1	(3.5)
Δ%	-18%		

South

Year	MS-1 Water Reserves	Change**	(%)
1977	367.4	--	--
1985	300.0	4.8	(1.6)
1990	272.0	5.4	(2.0)
2000	224.9	7.3	(3.4)
2020	139.4	13.7	(10.9)
Δ77-2020	-228.0	-13.7	(-5.7)
%Δ	-62%		

Total Region

Year	MS-1 Water Reserves	Change**	(%)
1977	3,040.4	--	--
1985	2,887.7	8.3	(0.3)
1990	2,800.8	12.4	(0.5)
2000	2,607.5	12.1	(0.5)
2020	2,332.4	-2.4	(-0.1)
Δ77-2020	-708.0	2.4	(0.3)
%Δ	-23%		

* All values rounded to nearest 0.1 million acre-feet.

** Percent change from Baseline projection for same period. Dashes indicate no change from Baseline.

Table VI-2: MANAGEMENT STRATEGY ONE (MS-1) - CROPLAND ACRES - IRRIGATED, DRYLAND AND TOTALS, BY STATE WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1000 Acres)*

State	Year	MS-1 Irr.	MS-1 Dry	MS-1 Total	Differences (%)** Irr.	(%)	Dry	(%)	Total	(%)
Colorado	1977	600	1,685	2,285	-	-	-	-	-	-
	1985	560	1,710	2,270	-	-	-	-	-	-
	1990	565	1,710	2,275	35	(7.5)	-25	(-1.4)	10	(0.4)
	2000	530	1,735	2,265	30	(6.0)	-15	(-0.9)	15	(0.7)
	2020	470	1,765	2,235	105	(28.8)	-50	(-2.8)	55	(2.5)
	△77-2020	-130	80	-50	105	(42.9)	-50	(38.5)	55	(52.4)
Kansas	1977	2,180	3,965	6,145	-	-	-	-	-	-
	1985	1,865	5,015	6,880	80	(4.5)	5	(0.1)	85	(1.3)
	1990	1,265	5,475	6,740	175	(16.1)	5	(0.1)	180	(2.7)
	2000	1,585	6,030	7,615	825	(108.6)	-15	(-0.2)	810	(11.9)
	2020	1,295	6,455	7,750	715	(123.3)	5	(0.1)	720	(10.2)
	△77-2020	-885	2,490	1,605	715	(44.7)	5	(0.2)	720	(81.4)
Nebraska	1977	4,700	5,945	10,645	-	-	-	-	-	-
	1985	6,750	4,940	11,690	-	-	-	-	-	-
	1990	7,880	4,390	12,270	20	(0.2)	-10	(-0.2)	10	(0.1)
	2000	9,845	3,635	13,480	25	(0.3)	-25	(-0.7)	-	-
	2020	11,540	3,495	15,035	75	(0.7)	-65	(-1.8)	10	(0.1)
	△77-2020	6,840	-2,450	4,390	75	(1.1)	-65	(-2.7)	10	(0.2)
New Mexico	1977	440	505	945	-	-	-	-	-	-
	1985	445	510	955	-	-	-	-	-	-
	1990	420	545	965	5	(1.2)	-	-	5	(0.5)
	2000	370	615	985	15	(4.2)	-	-	15	(1.5)
	2020	295	690	985	50	(20.4)	-40	(-5.5)	10	(1.0)
	△77-2020	-145	185	40	50	(25.6)	-40	(-17.4)	10	(33.3)
Oklahoma	1977	395	1,355	1,750	-	-	-	-	-	-
	1985	510	1,240	1,750	-	-	-	-	-	-
	1990	345	1,410	1,755	-	-	-	-	-	-
	2000	415	1,340	1,755	-	-	-	-	-	-
	2020	450	1,305	1,755	-	-	-	-	-	-
	△77-2020	55	-50	5	-	-	-	-	-	-
Texas	1977	5,970	4,815	10,785	-	-	-	-	-	-
	1985	5,920	5,035	10,955	-	-	-	-	-	-
	1990	5,635	5,110	10,745	40	(0.7)	-40	(-0.8)	-	-
	2000	5,500	5,195	10,695	-	-	-	-	-	-
	2020	4,940	5,690	10,630	-	-	-	-	-	-
	△77-2020	-1,030	875	-155	-	-	-	-	-	-

* All values rounded to nearest 5 thousand acres. Dashes indicate no change from Baseline.

** Percent change from Baseline projection for same period.

Table VI-2.1: MANAGEMENT STRATEGY ONE (MS-1) - CROPLAND ACRES - IRRIGATED, DRYLAND AND TOTALS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1000 Acres)*

Subregion Region	Year	MS-1 Irr.	MS-1 Dry	MS-1 Total	Differences (%)** Irr.	(%)	Dry	(%)	Total	(%)
North	1977	7,480	11,595	19,075	-	-	-	-	-	-
	1985	9,175	11,665	20,840	80	(0.9)	5	-	85	(0.4)
	1990	9,710	11,575	21,285	230	(2.4)	-30	(-0.3)	200	(0.9)
	2000	11,960	11,400	23,360	880	(7.9)	-55	(-0.5)	825	(3.7)
	2020	13,305	11,710	25,015	895	(7.2)	-115	(-1.0)	780	(3.2)
△77-2020		5,825	115	5,940	895	(18.2)	-115	(-50.0)	780	(15.1)
South	1977	6,805	6,675	13,480	-	-	-	-	-	-
	1985	6,875	6,785	13,660	-	-	-	-	-	-
	1990	6,400	7,070	13,470	45	(0.7)	-35	(-0.5)	10	(0.1)
	2000	6,280	7,150	13,430	10	(0.2)	-	-	10	(0.1)
	2020	5,685	7,685	13,370	50	(0.9)	-40	(-0.5)	10	(0.1)
△77-2020		-1,115	1,010	-105	50	(4.3)	-40	(-3.8)	10	(9.1)
Total Region	1977	14,285	18,270	32,555	-	-	-	-	-	-
	1985	16,055	18,450	34,505	85	(0.5)	5	-	90	(0.3)
	1990	16,110	18,645	34,755	275	(1.7)	-65	(-0.3)	210	(0.6)
	2000	18,240	18,550	36,790	890	(5.1)	-55	(-0.3)	835	(2.3)
	2020	18,990	19,395	38,385	945	(5.2)	-155	(-0.8)	790	(2.1)
△77-2020		4,705	1,125	5,830	945	(25.1)	-155	(-12.1)	790	(15.7)

* All values rounded to nearest 5 thousand acres. Regional totals may not be additive from subregional values due to rounding. Dashes indicate no change from Baseline.

** Percent changes from Bseline projection for same period.

Table VI-2.2: MANAGEMENT STRATEGY ONE (MS-1) - CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS (Millions of Bushels)*

State	Year	Wheat	(%△)**	Corn	(%△)**	Sorghum	(%△)**
Colorado	1977	36.9	-	56.4	-	6.5	-
	1985	39.0	-	60.7	-	6.2	-
	1990	42.8	(-0.7)	67.3	(5.3)	5.1	(27.5)
	2000	48.7	(-0.8)	73.4	(6.5)	4.2	(10.5)
	2020	58.7	(-9.0)	66.2	(35.1)	2.8	(7.7)
	△77-2020	21.8	(-21.0)	9.8	(232.4)	-3.7	(-5.1)
Kansas	1977	127.8	-	91.3	-	37.4	-
	1985	149.0	(-0.1)	105.4	(8.8)	52.3	-
	1990	167.8	(0.1)	58.8	(50.8)	58.9	-
	2000	198.6	(-0.3)	133.2	(443.7)	70.8	-
	2020	253.0	(1.9)	108.5	(294.5)	95.1	-
	△77-2020	125.2	(4.0)	17.2	(127.0)	57.7	-
Nebraska	1977	79.7	-	539.0	-	108.0	-
	1985	74.6	(0.1)	829.2	(0.1)	120.1	-
	1990	67.5	(-0.1)	978.2	(0.2)	121.3	(-0.2)
	2000	56.9	(-0.4)	1,290.6	(0.3)	121.1	(-0.7)
	2020	60.4	(-0.7)	1,631.3	(0.6)	150.5	(-1.8)
	△77-2020	-19.3	(2.2)	1,092.3	(0.9)	42.5	(-6.2)
New Mexico	1977	9.4	-	12.4	-	11.8	-
	1985	9.7	-	18.1	(-0.5)	15.5	(2.0)
	1990	12.9	(-3.0)	19.1	(-2.1)	13.7	-
	2000	15.6	(1.3)	16.8	(-2.9)	13.3	(2.3)
	2020	20.1	(-2.4)	14.3	(6.7)	9.1	(37.9)
	△77-2020	10.7	(-4.5)	1.9	(90.0)	-2.7	(-48.1)
Oklahoma	1977	22.8	-	6.4	-	14.5	-
	1985	27.9	-	8.4	-	19.5	-
	1990	26.3	(-0.1)	9.9	-	21.8	-
	2000	31.6	-	12.1	-	27.5	(-0.4)
	2020	42.6	(-0.1)	14.7	-	32.0	-
	△77-2020	19.8	(-0.5)	8.3	-	17.5	-
Texas	1977	50.9	-	157.3	-	121.4	-
	1985	35.4	-	91.3	(2.9)	137.8	(-1.6)
	1990	31.7	(-1.2)	47.1	(9.3)	138.6	(-1.6)
	2000	32.2	-	19.3	(-1.5)	178.3	(-1.3)
	2020	35.0	-	11.7	(-0.9)	188.7	(-1.2)
	△77-2020	-15.9	-	-146.1	(0.1)	67.3	(-3.3)

* All values rounded to nearest 0.1 million bushel for wheat, corn and sorghum. Dashes indicate no change from Baseline.

** Percent change (increase or decrease) from Baseline projection for same period. Table VI-2.2 continued on following page.

Table VI-2.2: MANAGEMENT STRATEGY ONE (MS-1) - CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS (Millions of Bushels)* (Cont'd)

State	Year	Soybeans (Million Bushels)	(%△)**	Alfalfa (1000 Tons)	(%△)**	Cotton (1000 Bales)	(%△)**
Colorado	1977	-	-	180	-	-	-
	1985	-	-	174	-	-	-
	1990	-	-	192	(7.3)	-	-
	2000	-	-	195	(12.1)	-	-
	2020	-	-	193	(40.9)	-	-
	△77-2020	-	-	13	(130.2)	-	-
Kansas	1977	0.6	-	999	-	-	-
	1985	1.5	(23.1)	1,088	(1.4)	-	-
	1990	3.0	(20.0)	1,338	(4.0)	-	-
	2000	5.8	(38.1)	1,459	(6.5)	-	-
	2020	7.7	(48.1)	1,842	(34.7)	-	-
	△77-2020	7.1	(54.3)	843	(129.1)	-	-
Nebraska	1977	8.5	-	3,315	-	-	-
	1985	41.1	-	3,590	-	-	-
	1990	67.2	-	3,696	-	-	-
	2000	107.7	(0.1)	3,713	(-0.1)	-	-
	2020	161.7	(0.2)	3,784	(-0.3)	-	-
	△77-2020	153.2	(0.3)	469	(-2.3)	-	-
New Mexico	1977	-	-	243	-	42	-
	1985	-	-	392	(-1.0)	43	(-4.4)
	1990	-	-	469	(7.1)	46	(12.2)
	2000	-	-	473	(-4.6)	55	(14.6)
	2020	-	-	574	(16.7)	53	(-3.6)
	△77-2020	-	-	331	(32.9)	11	(-15.4)
Oklahoma	1977	-	-	230	-	-	-
	1985	-	-	279	-	-	-
	1990	-	-	285	-	-	-
	2000	-	-	290	-	-	-
	2020	-	-	296	-	-	-
	△77-2020	-	-	66	-	-	-
Texas	1977	5.4	-	546	-	2,916	-
	1985	23.0	-	589	(1.0)	4,290	-
	1990	27.0	(0.4)	660	(5.6)	4,925	(0.5)
	2000	7.9	-	720	(6.3)	5,717	(0.3)
	2020	3.4	-	1,013	(19.7)	5,881	(-0.1)
	△77-2020	-2.0	-	467	(55.2)	2,965	(-0.2)

* Soybean values rounded to nearest 0.1 million bushels; alfalfa rounded to nearest 1 thousand tons; cotton rounded to nearest 1,000 bales.

** Percent change (increase or decrease) from Baseline projection for same period. Dashes indicate no change from Baseline.

Table VI-2.3: MANAGEMENT STRATEGY ONE (MS-1) - CROP PRODUCTION FOR SIX MAJOR CROPS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE PROJECTIONS*

Subregion/ Region	Year	Wheat	(%△)**	Corn	(%△)**	Sorghum	(%△)**	Soybean	(%△)**	Alfalfa	(%△)**	Cotton	(%△)**
		----Millions of Bushels----								(1000 Tons)		(1000 Bales)	
North	1977	244.4	-	686.6	-	151.9	-	9.2	-	4,494	-	-	-
	1985	262.6	-	995.2	(0.9)	178.6	-	42.7	(0.7)	4,852	(0.3)	-	-
	1990	278.1	(-0.1)	1,104.3	(2.3)	185.3	(0.5)	70.2	(0.9)	5,226	(1.2)	-	-
	2000	304.1	(-0.4)	1,497.1	(8.5)	196.1	(-0.2)	113.5	(1.5)	5,367	(2.0)	-	-
	2020	372.1	(-0.3)	1,806.1	(6.3)	248.5	(-1.0)	169.4	(1.7)	5,819	(9.8)	-	-
	△77-2020	127.7	(-1.1)	1,119.5	(10.6)	96.6	(-2.5)	160.2	(1.9)	1,325	(62.5)	-	-
South	1977	83.1	-	176.1	-	147.8	-	5.4	-	1,019	-	2,958	-
	1985	72.9	(-0.1)	117.7	(2.1)	172.7	(-1.1)	23.0	-	1,260	(0.2)	4,333	-
	1990	71.0	(-1.0)	76.2	(5.0)	174.2	(-1.2)	27.0	(0.4)	1,414	(4.9)	4,971	(0.6)
	2000	79.4	(0.3)	48.1	(-2.0)	219.3	(-0.9)	7.9	-	1,483	(1.4)	5,772	(0.4)
	2020	97.8	(-0.5)	40.3	(1.8)	229.9	(0.1)	3.4	-	1,883	(15.2)	5,934	(-0.1)
	△77-2020	14.7	(-3.3)	-135.8	(-0.5)	82.1	(0.4)	-2.0	-	864	(44.0)	2,976	(-0.3)
Region	1977	327.5	-	862.7	-	299.7	-	14.6	-	5,513	-	2,958	-
	1985	335.6	-	1,113.0	(1.0)	351.3	(-0.6)	65.7	(0.5)	6,112	(0.3)	4,333	-
	1990	349.0	(-0.3)	1,180.4	(2.5)	359.4	(-0.4)	97.2	(0.6)	6,540	(0.5)	4,971	(0.6)
	2000	383.6	(-0.3)	1,545.3	(8.1)	415.4	(-0.6)	121.4	(1.4)	6,850	(1.9)	5,772	(0.4)
	2020	469.9	(-0.4)	1,846.4	(6.2)	478.3	(-0.5)	172.8	(1.8)	7,702	(11.1)	5,934	(-0.1)
	△77-2020	142.4	(-1.3)	983.7	(12.4)	178.6	(-1.3)	158.2	(1.9)	2,189	(57.1)	2,976	(-0.3)

* Values for wheat, corn, sorghum and soybean rounded to nearest 0.1 million bushels; alfalfa to nearest 1000 tons; and cotton to nearest 1000 bales. Subregional and regional totals may not be exactly additive from state values due to rounding.

** Percent change from Baseline Projection for same period. Dashes indicates no change from Baseline.

Table VI-3: MANAGEMENT STRATEGY ONE (MS-1) - VALUE OF AGRICULTURAL PRODUCTION, BY STATE, SUBREGION AND REGIONAL TOTALS WITH COMPARISON TO BASELINE FOR 1977 TO 2020 (Millions 1977 $)*

State	Year	MS-1	Change	(%)**
Colorado	1977	275	--	--
	1985	315	--	--
	1990	350	10	(2.9)
	2000	400	15	(3.9)
	2020	445	50	(12.7)
	△77-2020	170	50	(41.7)
Kansas	1977	655	--	--
	1985	880	20	(2.3)
	1990	860	55	(6.8)
	2000	1,250	315	(33.7)
	2020	1,555	295	(23.4)
	△77-2020	900	295	(48.8)
Nebraska	1977	1,680	--	--
	1985	2,935	--	--
	1990	3,500	5	(0.1)
	2000	4,775	10	(0.2)
	2020	6,475	20	(0.3)
	△77-2020	4,795	20	(0.4)
New Mexico	1977	125	--	--
	1985	185	--	--
	1990	195	--	--
	2000	210	--	--
	2020	235	15	(6.8)
	△77-2020	110	15	(15.8)
Oklahoma	1977	130	--	--
	1985	190	--	--
	1990	195	--	--
	2000	245	--	--
	2020	325	--	--
	△77-2020	195	--	--
Texas	1977	1,705	--	--
	1985	2,290	--	--
	1990	2,395	15	(0.6)
	2000	2,640	5	(0.2)
	2020	2,840	5	(0.2)
	△77-2020	1,135	5	(0.4)

Subregions/Region

North

Year	MS-1	Change	(%)**
1977	2,610	--	--
1985	4,135	25	(0.6)
1990	4,710	70	(1.5)
2000	6,420	330	(5.4)
2020	8,475	365	(4.5)
△77-2020	5,865	365	(6.6)

South

Year	MS-1	Change	(%)**
1977	1,960	--	--
1985	2,665	5	(0.2)
1990	2,785	15	(0.5)
2000	3,095	--	--
2020	3,400	15	(0.4)
△77-2020	1,440	15	(1.1)

Total Region

Year	MS-1	Change	(%)**
1977	4,570	--	--
1985	6,795	25	(0.4)
1990	7,495	85	(1.1)
2000	9,520	335	(3.6)
2020	11,875	380	(3.3)
△77-2020	7,305	380	(5.5)

* All values rounded to nearest $5 million. Dashes indicate no change from Baseline.

** Percent change from Baseline projection for same period.

Table VI-4: MANAGEMENT STRATEGY ONE (MS-1) - RETURNS TO LAND AND MANAGEMENT FROM AGRICULTURAL PRODUCTION, BY STATE, SUBREGION AND REGIONAL TOTALS WITH COMPARISON TO BASELINE FOR 1977 TO 2020 (Millions 1977 $)*

State	Year	MS-1	Change	(%)**
Colorado	1977	90	--	--
	1985	95	--	--
	1990	100	10	(11.1)
	2000	135	15	(12.5)
	2020	190	30	(18.7)
	△77-2020	100	30	(42.9)
Kansas	1977	210	--	--
	1985	315	--	--
	1990	380	--	--
	2000	560	10	(1.8)
	2020	875	20	(2.3)
	△77-2020	665	20	(3.1)
Nebraska	1977	555	--	--
	1985	1,165	15	(1.3)
	1990	1,325	20	(1.5)
	2000	2,030	--	--
	2020	2,970	-5	(-0.2)
	△77-2020	2,415	-5	(-0.2)
New Mexico	1977	25	--	--
	1985	60	--	--
	1990	70	5	(7.7)
	2000	90	--	--
	2020	125	10	(8.7)
	△77-2020	100	10	(11.1)
Oklahoma	1977	30	--	--
	1985	40	--	--
	1990	30	--	--
	2000	50	--	--
	2020	70	--	--
	△77-2020	40	--	--
Texas	1977	145	--	--
	1985	375	55	(17.2)
	1990	435	--	--
	2000	580	15	(2.7)
	2020	755	20	(2.7)
	△77-2020	610	20	(3.4)

Subregions/Region

North

Year	MS-1	Change	(%)**
1977	850	--	--
1985	1,575	20	(1.3)
1990	1,805	30	(1.7)
2000	2,725	25	(0.9)
2020	4,035	45	(1.1)
△77-2020	3,185	45	(1.4)

South

Year	MS-1	Change	(%)**
1977	200	--	--
1985	475	55	(13.1)
1990	530	--	--
2000	720	20	(2.9)
2020	955	35	(3.8)
△77-2020	755	35	(4.9)

Total Region

Year	MS-1	Change	(%)**
1977	1,050	--	--
1985	2,045	70	(3.5)
1990	2,335	30	(1.3)
2000	3,445	40	(1.2)
2020	4,985	75	(1.5)
△77-2020	3,935	75	(1.9)

* All values rounded to nearest $5 million. Dashes indicate no change from Baseline.

** Percent change from Baseline projection for same period.

Table VI-5: MANAGEMENT STRATEGY ONE (MS-1) REGIONAL ECONOMY - TOTAL VALUE ADDED, ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 Dollars)*

Region	Year	MS-1	Difference	(%)**
North	1977	7,047	-	-
	1985	10,893	24	(0.2)
	1990	12,028	71	(0.6)
	2000	15,099	346	(2.3)
	2020	20,048	412	(2.1)
	△77-2020	13,001	412	(3.3)
	%△	184%		
South	1977	14,406	-	-
	1985	21,435	6	(0.03)
	1990	26,662	19	(0.1)
	2000	29,844	18	(0.1)
	2020	29,577	37	(0.1)
	△ 77-2020	15,171	37	(0.2)
	%△	105%		
Total Region	1977	21,453	-	-
	1985	32,328	30	(0.1)
	1990	38,690	90	(0.2)
	2000	44,943	364	(0.8)
	2020	49,625	449	(0.9)
	△77-2020	28,171	449	(1.6)
	%△	131%		

* Values rounded to nearest $1 million. Dashes indicate no change from Baseline.

** Percent change from Baseline projection.

Table VI-6: MANAGEMENT STRATEGY ONE (MS-1) REGIONAL ECONOMY - VALUE ADDED, BY AGRICULTURALLY RELATED SECTORS WITH COMPARISON TO BASELINE PROJECTIONS FOR 1985 to 2020 (Millions 1977 Dollars)*

Region	Year	MS-1	(%) **	Difference	(%)***
North	1977	2,573	(36.5)	--	--
	1985	4,325	(39.7)	23	(0.5)
	1990	4,811	(40.0)	64	(1.3)
	2000	6,637	(44.0)	327	(5.2)
	2020	9,298	(46.4)	384	(4.3)
	△ 77-2020	6,725	(51.7)	384	(6.1)
	% △	261%			
South	1977	1,669	(11.6)	--	--
	1985	2,141	(10.0)	6	(0.3)
	1990	2,298	(8.6)	16	(0.7)
	2000	3,050	(10.2)	8	(0.3)
	2020	3,926	(13.3)	18	(0.5)
	△ 77-2020	2,257	(14.9)	18	(0.8)
	% △	135%			
Total Region	1977	4,242	(19.8)	--	--
	1985	6,466	(20.0)	29	(0.5)
	1990	7,109	(18.4)	80	(1.1)
	2000	9,687	(21.6)	335	(3.6)
	2020	13,224	(26.6)	402	(3.1)
	△ 77-2020	8,982	(31.9)	402	(4.7)
	% △	212%			

* All values rounded to nearest $1 million.

** Agriculturally related value added as a percentage of Total Value Added.

*** Percentage change from Baseline to MS-1 projections. Dashes indicate no change from Baseline.

Table VI-7: MANAGEMENT STRATEGY ONE (MS-1) REGIONAL ECONOMY - TOTAL EMPLOYMENT BY SUBREGION AND REGION, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (1,000's of Full-Time Equivalent Jobs)*

Region	Year	MS-1	Difference	(%)**
North	1977	444.2	-	-
	1985	540.2	1.4	(0.3)
	1990	536.9	3.6	(0.7)
	2000	549.9	12.9	(2.4)
	2020	567.8	13.1	(2.4)
	△ 77-2020	123.6	13.1	(11.9)
	% △	28%		
South	1977	563.6	-	-
	1985	657.1	0.4	(0.1)
	1990	704.4	1.1	(0.2)
	2000	795.3	0.7	(0.1)
	2020	779.6	1.2	(0.2)
	△ 77-2020	216.0	1.2	(0.6)
	% △	38%		
Total Region	1977	1,007.8	-	-
	1985	1,197.3	1.8	(0.2)
	1990	1,241.3	4.7	(0.4)
	2000	1,345.2	13.6	(1.0)
	2020	1,347.4	14.2	(1.1)
	△ 77-2020	339.6	14.2	(4.4)
	% △	34%		

* Number of jobs rounded to nearest 0.1 thousand.

** Percentage change from Baseline to MS-1 projections.

Table VI-7.1: MANAGEMENT STRATEGY ONE (MS-1) REGIONAL ECONOMY - TOTAL HOUSEHOLD INCOME FROM ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions of 1977 $)*

Region	Year	MS-1	Difference	(%)**
North	1977	4,909	-	-
	1985	7,073	14	(0.2)
	1990	7,760	42	(0.6)
	2000	9,937	198	(2.0)
	2020	13,593	237	(1.8)
	△ 77-2020	8,685	237	(2.8)
	% △	177%		
South	1977	7,575	-	-
	1985	11,166	6	(0.1)
	1990	14,181	16	(0.1)
	2000	18,830	15	(0.1)
	2020	23,589	32	(0.1)
	△ 77-2020	16,014	32	(0.2)
	% △	211%		
Total Region	1977	12,484	-	-
	1985	18,238	19	(0.1)
	1990	21,942	59	(0.3)
	2000	28,767	213	(0.8)
	2020	37,182	269	(0.7)
	△ 77-2020	24,698	269	(1.1)
	% △	198%		

* All values rounded to nearest $1 million.

** Percentage change from Baseline to MS-1 projections.

Table VI-8: MANAGEMENT STRATEGY ONE (MS-1) - POPULATION PROJECTIONS, BY SUBREGION AND REGION, WITH COMPARISONS TO BASELINE PROJECTIONS (1000's of Persons)*

Subregion Region	Year	MS-1	Change	(%) **
North	1977	903	-	-
	1985	1,098	5	(0.5)
	1990	1,090	6	(0.6)
	2000	1,116	25	(2.3)
	2020	1,153	25	(2.2)
	△77-2020	250	25	(11.1)
	%△	28%		
South	1977	1,268	-	-
	1985	1,485	1	(0.1)
	1990	1,596	1	(0.1)
	2000	1,813	2	(0.1)
	2020	1,790	3	(0.2)
	△77-2020	522	3	(0.6)
	%△	41%		
Total Region	1977	2,171	-	-
	1985	2,583	6	(0.2)
	1990	2,686	7	(0.3)
	2000	2,929	27	(0.9)
	2020	2,943	28	(1.0)
	△77-2020	772	28	(3.8)
	%△	36%		

* All values rounded to nearest 1,000 persons.

** Percent change from Baseline projections.

Table VI-9: MANAGEMENT STRATEGY ONE (MS-1) - AVERAGE PER CAPITA INCOME*, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE PROJECTIONS (1977 Dollars)**

Subregion/ Region	Year	MS-1	Change	(%)***
North	1977	5,436	-	-
	1985	6,442	-16	(-0.2)
	1990	7,119	-1	(-0.01)
	2000	8,904	-23	(-0.3)
	2020	11,789	-51	(-0.4)
	△ 77-2020	6,353	-51	(-0.8)
	% △	117%		
South	1977	5,974	-	-
	1985	7,519	-1	(-0.01)
	1990	8,885	4	(0.05)
	2000	10,386	-3	(-0.03)
	2020	13,178	-4	(-0.03)
	△ 77-2020	7,204	-4	(-0.1)
	% △	121%		
Total Region	1977	5,750	-	-
	1985	7,061	-9	(-0.1)
	1990	8,169	1	(0.01)
	2000	9,821	-18	(-0.2)
	2020	12,634	-29	(-0.2)
	△ 77-2020	6,884	-29	(-0.4)
	% △	120%		

* Average Per Capita Income is Total Household Income divided by population

** All values rounded to nearest $1.

*** Percent change from Baseline projections.

Table VI-10: MANAGEMENT STRATEGY ONE (MS-1) REGIONAL ECONOMY - STATE AND LOCAL GOVERNMENT REVENUE GROWTH FROM ALL SECTORS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 Dollars)*

Region	Year	MS-1	Difference (%)**	
North	1977	308.4	-	-
	1985	499.1	0.8	(0.2)
	1990	541.5	2.3	(0.4)
	2000	646.7	11.8	(1.9)
	2020	860.3	14.2	(1.7)
	△ 77-2020	551.9	14.2	(2.6)
	% △	179%		
South	1977	564.6	-	-
	1985	728.3	0.3	(0.04)
	1990	978.1	0.6	(0.1)
	2000	840.4	0.4	(0.05)
	2020	548.4	0.7	(0.1)
	△ 77-2020	-16.2	0.7	(4.1)
	% △	-3%		
Total Region	1977	872.9	-	-
	1985	1,227.4	1.1	(0.1)
	1990	1,519.7	3.0	(0.2)
	2000	1,487.1	12.2	(0.8)
	2020	1,408.7	14.9	(1.1)
	△ 77-2020	535.8	14.9	(2.9)
	% △	61%		

* All values rounded to nearest $0.1 million.

** Percentage change from Baseline to MS-1 projections.

MANAGEMENT STRATEGY TWO

(MS-2)

Table VI-11: MANAGEMENT STRATEGY TWO (MS-2) - ANNUAL WATER USE RATES BY STATE, SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE FOR 1977 TO 2020 (1000 Acre-Feet per Year)*

State	Year	MS-2	Change	(%)**
Colorado	1977	1,150	-	-
	1985	970	-105	(-9.8)
	1990	815	-190	(-18.9)
	2000	655	-310	(-32.1)
	2020	585	-70	(-10.7)
	△ 77-2020	-565	-70	(-14.1)
	% △	-49%		
Kansas	1977	3,280	-	-
	1985	2,180	-410	(-15.8)
	1990	1,320	-220	(-14.3)
	2000	1,520	505	(49.8)
	2020	1,080	255	(30.9)
	△ 77-2020	-2,200	255	(10.4)
	% △	-67%		
Nebraska	1977	7,835	-	-
	1985	8,395	-1,825	(-17.9)
	1990	8,195	-3,160	(-27.8)
	2000	8,905	-4,060	(-31.3)
	2020	10,420	-4,380	(-29.6)
	△ 77-2020	2,585	-4,380	(-62.9)
	% △	33%		
New Mexico	1977	965	-	-
	1985	880	-120	(-12.0)
	1990	725	-215	(-22.9)
	2000	535	-290	(-35.2)
	2020	485	-70	(-12.6)
	△ 77-2020	-480	-70	(-17.1)
	% △	-50%		
Oklahoma	1977	670	-	-
	1985	650	-105	(-13.9)
	1990	445	-160	(-26.4)
	2000	425	-370	(-46.5)
	2020	380	-440	(-53.7)
	△ 77-2020	-290	-440	(-293.3)
	% △	-43%		
Texas	1977	8,240	-	-
	1985	4,040	-1,565	(-27.9)
	1990	3,015	-805	(-21.1)
	2000	2,375	-1,200	(-33.6)
	2020	2,055	-1,180	(-36.5)
	△ 77-2020	-6,185	-1,180	(-23.7)
	% △	-75%		

Subregions/Region

Subregion	Year	MS-2	Change	(%)**
North	1977	12,265	-	-
	1985	11,545	-2,340	(-16.9)
	1990	10,330	-3,570	(-25.7)
	2000	11,080	-3,865	(-25.9)
	2020	12,085	-4,195	(-25.8)
	△ 77-2020	-180	4,195	(104.5)
	% △	15%		
South	1977	9,875	-	-
	1985	5,570	-1,790	(-24.3)
	1990	4,185	-1,180	(-22.0)
	2000	3,335	-1,860	(-35.8)
	2020	2,920	-1,690	(-36.7)
	△ 77-2020	-6,955	-1,690	(-32.1)
	% △	70%		
Total Region	1977	22,140	-	-
	1985	17,115	-4,130	(-19.4)
	1990	14,515	-4,750	(-24.7)
	2000	14,415	-5,725	(-28.4)
	2020	15,005	-5,885	(-28.2)
	△77-2020	-7,135	-5,885	(-470.8)
	% △	32%		

* All values rounded to nearest 5 thousand acre-feet.

** Percent change from baseline for each period.

Table VI-12: MANAGEMENT STRATEGY TWO (MS-2) - OGALLALA WATER REMAINING IN STORAGE BY STATE, SUBREGION AND REGIONAL TOTALS, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions of Acre-Feet)*

State	Year	MS-2 Water Reserves	Change	(%)**
Colorado	1977	93.6	-	-
	1985	89.4	-	-
	1990	86.8	0.5	(0.6)
	2000	82.8	2.0	(2.5)
	2020	79.1	8.5	(12.0)
	△77-2020	-14.5	8.5	(37.0)
	%△	-15%		
Kansas	1977	244.4	-	-
	1985	220.7	0.1	-
	1990	211.3	2.0	(1.0)
	2000	201.2	4.2	(2.1)
	2020	176.2	6.3	(3.4)
	△77-2020	-68.2	-6.3	(-10.2)
	%△	-28%		
Nebraska	1977	2,335.0	-	-
	1985	2,281.3	7.3	(0.3)
	1990	2,238.4	12.4	(0.6)
	2000	2,134.1	36.1	(1.7)
	2020	2,044.7	88.7	(4.5)
	△77-2020	-290.3	88.7	(23.4)
	%△	-12%		
New Mexico	1977	23.8	-	-
	1985	21.0	0.5	(2.4)
	1990	19.2	0.8	(4.3)
	2000	17.3	2.5	(16.9)
	2020	13.3	3.8	(40.0)
	△77-2020	-10.5	3.8	(26.6)
	%△	-44%		
Oklahoma	1977	59.9	-	-
	1985	55.0	0.4	(0.7)
	1990	51.5	0.1	(0.2)
	2000	47.1	2.6	(5.8)
	2020	37.5	8.5	(29.3)
	△77-2020	-22.4	8.5	(27.5)
	%△	-37%		
Texas	1977	283.7	-	-
	1985	226.4	6.3	(2.9)
	1990	202.9	5.9	(3.0)
	2000	168.3	10.0	(6.3)
	2020	112.2	25.0	(28.7)
	△77-2020	-171.5	25.0	(13.4)
	%△	-60%		

Subregions/Region

North

Year	MS-2 Water Reserves	Change	(%)**
1977	2,673.0	-	-
1985	2,591.4	7.2	(0.3)
1990	2,536.5	14.9	(0.6)
2000	2,418.1	42.3	(1.8)
2020	2,300.0	90.9	(4.1)
△77-2020	-373.0	90.9	(19.6)
%△	-14%		

South

Year	MS-2 Water Reserves	Change	(%)**
1977	367.4	-	-
1985	302.4	7.2	(2.4)
1990	273.6	6.8	(2.5)
2000	232.7	15.1	(6.9)
2020	163.0	37.3	(29.7)
△77-2020	-204.4	37.3	(15.4)
%△	-56%		

Total Region

Year	MS-2 Water Reserves	Change	(%)**
1977	3,040.4	-	-
1985	2,893.8	14.4	(0.5)
1990	2,810.1	21.7	(0.8)
2000	2,650.8	57.4	(2.2)
2020	2,463.0	128.2	(5.5)
△77-2020	-577.4	128.2	(17.5)
%△	19%		

* All values rounded to nearest 0.1 million acre-feet.

**Percent change from Baseline projection for same period.

Table VI-13: MANAGEMENT STRATEGY TWO (MS-2) - CROPLAND ACREAGE - IRRIGATED, DRYLAND, AND TOTALS, BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS (1000's Acres)*

State	Year	MS-2 Acreages (1000's) Irr.	Dry	Total	Change From Baseline Irr.	(%)**	Dry	(%)**	Total	(%)**
Colorado	1977	600	1,685	2,285	-	-	-	-	-	-
	1985	555	1,715	2,270	-5	(-0.9)	5	(0.3)	-	-
	1990	525	1,745	2,270	-5	(-0.9)	10	(0.6)	5	(0.2)
	2000	470	1,745	2,215	-30	(-6.0)	-5	(-0.3)	-45	(-2.0)
	2020	480	1,750	2,230	115	(31.5)	-65	(-3.6)	50	(2.3)
	△ 77-2020	-120	65	-55	115	(48.9)	-65	(-50.0)	50	(47.6)
Kansas	1977	2,180	3,965	6,145	-	-	-	-	-	-
	1985	1,695	5,140	6,835	-90	(-5.0)	130	(2.6)	40	(0.6)
	1990	1,055	5,645	6,700	-35	(-3.2)	175	(3.2)	140	(2.1)
	2000	1,165	6,130	7,295	405	(53.3)	85	(1.4)	490	(7.2)
	2020	860	6,515	7,395	280	(48.3)	65	(1.0)	345	(4.9)
	△ 77-2020	-1,320	2,550	1,230	280	(17.5)	65	(2.6)	345	(39.0)
Nebraska	1977	4,700	5,945	10,645	-	-	-	-	-	-
	1985	6,730	4,955	11,685	-20	(-0.3)	15	(0.3)	-5	(-0.04)
	1990	7,840	4,430	12,270	-20	(0.3)	30	(0.7)	10	(0.1)
	2000	9,855	3,640	13,495	35	(0.4)	-20	(-0.5)	15	(0.1)
	2020	11,940	3,145	15,085	475	(4.1)	-415	(-11.7)	60	(0.4)
	△ 77-2020	7,240	-2,800	4,440	475	(7.0)	-415	(-17.4)	60	(1.4)
New Mexico	1977	440	505	945	-	-	-	-	-	-
	1985	435	525	960	-10	(-2.2)	15	(2.9)	-	-
	1990	385	575	960	-30	(-7.2)	30	(5.5)	-	-
	2000	335	640	975	-20	(-5.6)	25	(4.1)	5	(0.5)
	2020	315	660	975	70	(28.6)	-70	(-9.6)	-	-
	△ 77-2020	-125	155	30	70	(35.9)	-70	(-31.1)	-	-
Oklahoma	1977	395	1,355	1,750	-	-	-	-	-	-
	1985	460	1,290	1,750	-50	(-9.8)	50	(4.0)	-	-
	1990	315	1,435	1,750	-30	(-8.7)	25	(1.8)	-5	(-0.3)
	2000	330	1,420	1,750	-85	(-20.5)	80	(6.0)	-5	(-0.3)
	2020	345	1,405	1,750	-105	(-23.3)	100	(7.7)	-5	(-0.3)
	△ 77-2020	-50	50	0	-105	(-190.9)	100	(200.0)	-5	(-100.0)
Texas	1977	5,970	4,815	10,785	-	-	-	-	-	-
	1985	5,510	5,435	10,945	-410	(-6.9)	400	(8.0)	-10	(-0.1)
	1990	4,935	5,755	10,690	-660	(-11.8)	605	(11.7)	-55	(-0.5)
	2000	4,555	6,080	10,635	-945	(-17.2)	885	(17.0)	-60	(-0.6)
	2020	4,095	6,455	10,550	-845	(-17.1)	765	(13.4)	-80	(-0.8)
	△ 77-2020	-1,875	1,640	-235	-845	(-82.0)	765	(87.4)	-80	(-51.6)

* All values rounded to nearest 5 thousand acres.

** Percent change from Baseline projections for same period. Dashes indicate no change from Baseline.

Table VI-13.1: MANAGEMENT STRATEGY TWO (MS-2) - CROPLAND ACRES - IRRIGATED, DRYLAND AND TOTALS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1000 Acres)*

Subregion Region	Year	MS-2 Irr.	MS-2 Dry	MS-2 Total	Change From Baseline Irr.	(%)**	Dry	(%)**	Total	(%)**
North	1977	7,480	11,595	19,075	-	-	-	-	-	-
	1985	8,980	11,810	20,790	-115	(-1.3)	150	(1.3)	35	(0.2)
	1990	9,420	11,820	21,240	-60	(-0.6)	215	(1.9)	155	(0.7)
	2000	11,490	11,515	23,005	410	(3.7)	60	(0.5)	470	(2.1)
	2020	13,280	11,410	24,690	870	(7.0)	-415	(-3.5)	455	(1.9)
	△ 77-2020	5,800	-185	5,615	870	(17.6)	-415	(-180.4)	455	(8.8)
	% △	78%	3%	29%						
South	1977	6,805	6,675	13,480	-	-	-	-	-	-
	1985	6,405	7,250	13,655	-470	(-6.8)	465	(6.9)	-5	(-0.04)
	1990	5,635	7,765	13,400	-720	(-11.4)	660	(9.3)	-60	(-0.4)
	2000	5,215	8,140	13,355	-1,055	(-16.8)	990	(13.7)	-65	(-0.5)
	2020	4,755	8,520	13,275	-880	(-15.6)	795	(10.3)	-85	(-0.6)
	△ 77-2020	-2,050	1,845	-205	-880	(-75.2)	795	(75.7)	-85	(-70.8)
	% △	30%	28%	2%						
Total Region	1977	14,285	18,270	32,555	-	-	-	-	-	-
	1985	15,385	19,060	34,445	-585	(-3.7)	615	(3.3)	30	(0.1)
	1990	15,055	19,585	34,640	-780	(-4.9)	875	(4.7)	95	(0.3)
	2000	16,705	19,655	36,360	-645	(-3.7)	1,050	(5.6)	405	(1.1)
	2020	18,035	19,930	37,965	-10	(-0.1)	380	(1.9)	370	(1.0)
	△ 77-2020	3,750	1,660	5,410	-10	(-0.3)	380	(29.7)	370	(7.3)
	% △	26%	9%	17%						

* All values rounded to nearest 5 thousand acres.

** Percentage change from Baseline projections for same period.

Table VI-13.2: MANAGEMENT STRATEGY TWO (MS-2) - CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 TO 2020 (Millions of Bushels)*

State	Year	Wheat	(%△)**	Corn	(%△)**	Sorghum	(%△)**
Colorado	1977	36.9	-	56.4	-	6.5	-
	1985	39.3	(0.8)	59.5	(-2.0)	6.1	(-1.6)
	1990	43.1	-	54.6	(-14.6)	5.1	(27.5)
	2000	49.1	-	56.6	(-17.9)	4.0	(5.3)
	2020	58.1	(-9.9)	44.2	(-9.8)	2.5	(-3.8)
	△77-2020	21.2		-12.2		-4.0	
	%△	57%		-22%		-62%	
Kansas	1977	127.8	-	91.3	-	37.4	-
	1985	149.4	(0.2)	94.7	(-2.3)	52.3	-
	1990	168.9	(0.8)	41.9	(7.4)	58.9	-
	2000	198.5	(-0.4)	86.4	(252.7)	70.8	-
	2020	252.7	(1.8)	59.3	(115.6)	95.1	-
	△77-2020	124.9		-32.0		57.7	
	%△	98%		-35%		154%	
Nebraska	1977	79.7	-	539.0	-	108.0	-
	1985	74.8	(0.4)	804.4	(-3.0)	118.0	(-1.7)
	1990	67.6	-	862.9	(-11.6)	118.2	(-2.7)
	2000	55.7	(-2.5)	1,104.3	(-14.2)	115.9	(-5.0)
	2020	57.1	(-6.1)	1,338.3	(-17.5)	237.0	(54.6)
	△77-2020	-22.6		799.3		129.0	
	%△	-28%		148%		119%	
New Mexico	1977	9.4	-	12.4	-	11.8	-
	1985	10.0	(3.1)	17.5	(-3.8)	15.3	(0.7)
	1990	15.5	(16.5)	15.9	(-18.5)	14.7	(6.5)
	2000	15.7	(1.9)	13.5	(-22.0)	17.8	(36.9)
	2020	19.3	(-6.3)	13.6	(1.5)	11.8	(78.8)
	△77-2020	9.9		1.2		0.0	
	%△	105%		10%		-	
Oklahoma	1977	22.8	-	6.4	-	14.5	-
	1985	27.0	(-3.2)	8.4	-	19.0	(-2.6)
	1990	26.6	(1.1)	9.8	(-1.0)	19.0	(-12.8)
	2000	31.9	(0.9)	11.9	(-1.7)	20.7	(-25.0)
	2020	42.9	(0.5)	13.6	(-7.5)	22.9	(-28.4)
	△77-2020	20.1		7.2		8.3	
	%△	88%		112%		57%	
Texas	1977	50.9	-	157.3	-	121.4	-
	1985	38.2	(7.9)	82.6	(-6.9)	126.9	(-9.4)
	1990	36.8	(14.6)	32.2	(-25.3)	124.5	(-11.6)
	2000	39.5	(22.7)	11.0	(-43.9)	134.1	(-25.7)
	2020	42.8	(22.3)	6.2	(-45.6)	143.5	(-24.9)
	△77-2020	-8.1		-151.1		22.1	
	%△	-16%		-96%		18%	

* All values rounded to nearest 0.1 million bushels.

** Percent change (increase or decrease) from Baseline Projections for same period. Table VI-13.2 continued on following page.

Table VI-13.2: MANAGEMENT STRATEGY TWO (MS-2) - CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 TO 2020 (Millions of Bushels)* (Cont'd)

State	Year	Soybeans (Million Bushels)	(%△)**	Alfalfa (1000 Tons)	(%△)**	Cotton (1000 Bales)	(%△)**
Colorado	1977	-	-	180	-	-	-
	1985	-	-	82	(-52.9)	-	-
	1990	-	-	85	(-52.5)	-	-
	2000	-	-	60	(-65.5)	-	-
	2020	-	-	58	(-57.7)	-	-
	△ 77-2020	-	-	-122		-	-
	% △	-	-	-68%		-	
Kansas	1977	0.6	-	999	-	-	-
	1985	1.2	(-7.7)	1,055	(-1.7)	-	-
	1990	2.9	(16.0)	1,281	(-0.4)	-	-
	2000	5.4	(28.6)	1,340	(-2.2)	-	-
	2020	6.4	(23.1)	1,745	(27.7)	-	-
	△ 77-2020	5.8		746		-	-
	% △	967%		75%		-	
Nebraska	1977	8.5	-	3,315	-	-	-
	1985	42.7	(3.9)	3,546	(-1.2)	-	-
	1990	78.4	(16.7)	3,655	(-1.1)	-	-
	2000	108.8	(1.1)	3,483	(-6.3)	-	-
	2020	144.3	(-10.5)	3,504	(-7.7)	-	-
	△ 77-2020	135.7		189		-	-
	% △	1,596%		6%		-	
New Mexico	1977	-	-	243	-	42	-
	1985	-	-	317	(-19.9)	48	(6.7)
	1990	-	-	179	(-59.1)	53	(29.3)
	2000	-	-	115	(-76.8)	77	(60.4)
	2020	-	-	366	(-25.6)	73	(32.7)
	△ 77-2020	-	-	123		31	
	% △	-	-	51%		74%	
Oklahoma	1977	-	-	230	-	-	-
	1985	-	-	278	(-0.4)	-	-
	1990	-	-	273	(-4.2)	-	-
	2000	-	-	275	(-5.2)	-	-
	2020	-	-	272	(-8.1)	-	-
	△ 77-2020	-	-	42		-	-
	% △	-	-	18%		-	
Texas	1977	5.4	-	546	-	2,916	-
	1985	18.7	(-18.7)	573	(-1.7)	4,117	(-4.0)
	1990	20.6	(-23.4)	568	(-9.1)	4,495	(-8.3)
	2000	4.6	(-41.8)	567	(-16.2)	5,009	(-12.1)
	2020	3.7	(8.8)	625	(-26.1)	5,234	(-11.1)
	△ 77-2020	-1.7		79		2,318	
	% △	-31%		14%		79%	

* Soybean values rounded to nearest 0.1 million bushel; alfalfa to nearest 1 thousand tons; and cotton to nearest 1 thousand bales.

** Percent change (increase or decrease) from Baseline Projections for same period. Dashes indicate no change from Baseline.

Table VI-13.3: MANAGEMENT STRATEGY TWO (MS-2) - CROP PRODUCTION FOR SIX MAJOR CROPS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020*

Subregion/ Region	Year	Wheat	(%Δ)**	Corn	(%Δ)**	Sorghum	(%Δ)**	Soybean	(%Δ)**	Alfalfa	(%Δ)**	Cotton	(%Δ)**
		Millions of Bushels								(1000 Tons)		(1000 Bales)	
North	1977	244.4	-	686.6	-	151.9	-	9.2	-	4,494	-	-	-
	1985	263.5	(0.3)	958.6	(-2.8)	176.4	(-1.2)	43.9	(3.5)	4,683	(-3.2)	-	-
	1990	279.6	(0.5)	959.4	(-11.1)	182.2	(-1.2)	81.3	(16.6)	5,021	(-2.7)	-	-
	2000	303.3	(-0.7)	1,247.3	(-9.6)	190.7	(-3.0)	114.2	(2.1)	4,883	(-7.2)	-	-
	2020	367.9	(-1.5)	1,441.8	(-15.1)	334.6	(33.3)	150.7	(-9.5)	5,307	(0.2)	-	-
	Δ 77-2020	123.5		755.1		182.7		141.5		813		-	-
	% Δ	51%		110%		120%		1,538%		18%		-	
South	1977	83.1	-	176.1	-	147.8	-	5.4	-	1,019	-	2,958	-
	1985	75.2	(3.0)	108.5	(-5.9)	161.2	(-7.7)	18.7	(-18.7)	1,168	(-7.2)	4,165	(-3.9)
	1990	78.9	(10.0)	57.9	(-20.1)	158.2	(-10.3)	20.6	(-23.4)	1,020	(-24.3)	4,548	(-8.0)
	2000	87.1	(10.0)	36.4	(-25.7)	172.6	(-22.0)	4.6	(-41.8)	957	(-34.6)	5,086	(-11.5)
	2020	105.0	(6.8)	33.4	(-15.4)	178.2	(-22.4)	3.7	(8.8)	1,263	(-22.7)	5,307	(-10.7)
	Δ 77-2020	21.9		-142.7		30.4		-1.7		244		2,349	
	% Δ	26%		-81%		21%		-31%		24%		79%	
Total Region	1977	327.5	-	862.7	-	299.7	-	14.6	-	5,513	-	2,958	-
	1985	338.7	(0.9)	1,067.1	(-3.2)	337.6	(-4.4)	62.6	(-4.3)	5,851	(-4.0)	4,165	(-3.9)
	1990	358.5	(2.4)	1,017.3	(-11.7)	340.4	(-5.7)	101.9	(5.5)	6,041	(-7.2)	4,548	(-8.0)
	2000	390.4	(1.5)	1,283.7	(-10.2)	363.3	(-13.0)	118.8	(-0.8)	5,840	(-13.2)	5,086	(-11.5)
	2020	472.9	(0.2)	1,475.2	(-15.1)	512.8	(6.7)	154.4	(-9.1)	6,570	(-5.2)	5,307	(-10.7)
	Δ 77-2020	145.4		612.4		213.1		139.8		1,057		2,349	
	% Δ	44%		71%		71%		958%		19%		79%	

* Wheat, corn, sorghum and soybean values rounded to nearest 0.1 million bushels; alfalfa to nearest one thousand tons, and cotton to nearest one thousand bales.

** Percent change from Baseline Projection for same period.

Table VI-14: MANAGEMENT STRATEGY TWO (MS-2) - VALUE OF AGRICULTURAL PRODUCTION, BY STATE, SUBREGION AND REGIONAL TOTALS WITH COMPARISON TO BASELINE FOR 1977 TO 2020 (Millions 1977 $)*

State	Year	MS-2	(%) Change**
Colorado	1977	275	-
	1985	305	(-3.2)
	1990	320	(-5.9)
	2000	345	(-10.4)
	2020	405	(2.5)
	△ 77-2020	130	
	% △	47%	
Kansas	1977	655	-
	1985	850	(-1.2)
	1990	820	(1.9)
	2000	1,115	(19.3)
	2020	1,385	(9.9)
	△ 77-2020	730	
	% △	111%	
Nebraska	1977	1,680	-
	1985	2,880	(-1.9)
	1990	3,285	(-6.0)
	2000	4,315	(-9.4)
	2020	5,760	(-10.8)
	△ 77-2020	4,080	
	% △	243%	
New Mexico	1977	125	-
	1985	175	(-5.4)
	1990	175	(-10.3)
	2000	185	(-11.9)
	2020	230	(4.5)
	△ 77-2020	105	
	% △	84%	
Oklahoma	1977	130	-
	1985	185	(-2.6)
	1990	190	(-2.6)
	2000	225	(-8.2)
	2020	295	(-9.2)
	△ 77-2020	165	
	% △	127%	
Texas	1977	1,705	-
	1985	2,200	(-3.9)
	1990	2,200	(-7.6)
	2000	2,335	(-11.4)
	2020	2,510	(-11.5)
	△ 77-2020	805	
	% △	47%	

Subregions/Region

North

Year	MS-2	(%) Change**
1977	2,610	-
1985	4,035	(-1.8)
1990	4,425	(-4.6)
2000	5,775	(-5.1)
2020	7,550	(-7.0)
△ 77-2020	4,940	
% △	189%	

South

Year	MS-2	(%) Change**
1977	1,960	-
1985	2,560	(-3.8)
1990	2,565	(-7.4)
2000	2,745	(-11.3)
2020	3,035	(-10.3)
△77-2020	1,075	
% △	55%	

Total Region

Year	MS-2	(%) Change**
1977	4,570	-
1985	6,595	(-2.6)
1990	6,990	(-5.7)
2000	8,520	(-7.2)
2020	10,585	(-7.9)
△ 77-2020	6,015	
% △	132%	

* All values rounded to nearest $5 million.

** Percent change from Baseline projection for same period.

Table VI-15: MANAGEMENT STRATEGY TWO (MS-2) - - RETURNS TO LAND AND MANAGEMENT BY STATE, SUBREGION AND REGIONAL TOTALS WITH COMPARISON TO BASELINE FOR 1977 TO 2020 (Millions 1977 $)*

State	Year	MS-2	(%) Change**
Colorado	1977	90	-
	1985	90	(-5.3)
	1990	85	(-5.5)
	2000	115	(-4.2)
	2020	170	(6.2)
	Δ 77-2020	80	
	% Δ	89%	
Kansas	1977	210	-
	1985	320	(1.6)
	1990	390	(2.6)
	2000	565	(2.7)
	2020	865	(1.2)
	Δ 77-2020	655	
	% Δ	312%	
Nebraska	1977	555	-
	1985	1,140	(-0.9)
	1990	1,255	(-3.8)
	2000	1,825	(-10.1)
	2020	2,630	(-11.6)
	Δ 77-2020	2,075	
	% Δ	374%	
New Mexico	1977	25	-
	1985	55	(-8.3)
	1990	60	(-7.7)
	2000	80	(-11.1)
	2020	120	(4.3)
	Δ 77-2020	95	
	% Δ	380%	
Oklahoma	1977	30	-
	1985	40	-
	1990	30	-
	2000	50	-
	2020	65	(-7.1)
	Δ 77-2020	35	
	% Δ	117%	
Texas	1977	145	-
	1985	370	(15.6)
	1990	405	(-6.9)
	2000	525	(-7.1)
	2020	695	(-5.4)
	Δ 77-2020	550	
	% Δ	379%	

Subregions/Region

Year	MS-2	(%) Change**
1977	850	-
1985	1,550	(-0.3)
1990	1,730	(-2.5)
2000	2,505	(-7.2)
2020	3,670	(-8.0)
Δ 77-2020	2,820	
% Δ	332%	

South

Year	MS-2	(%) Change**
1977	200	-
1985	465	(10.7)
1990	495	(-6.6)
2000	655	(-6.4)
2020	880	(-4.3)
Δ 77-2020	680	
% Δ	340%	

Total Region

Year	MS-2	(%) Change**
1977	1,050	-
1985	2,015	(2.0)
1990	2,225	(-3.5)
2000	3,160	(-7.2)
2020	4,550	(-7.3)
Δ 77-2020	3,500	
% Δ	333%	

* All values rounded to nearest $5 million. Subregional and regional totals may not be additive from state values due to rounding.

** Percent change from Baseline projection for same period.

Table VI-16: MANAGEMENT STRATEGY TWO (MS-2) REGIONAL ECONOMY - TOTAL VALUE ADDED, ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 Dollars)*

Region	Year	MS-2	Difference	(%)**
North	1977	7,047	-	-
	1985	10,788	-81	(-0.7)
	1990	11,699	-258	(-2.2)
	2000	14,378	-375	(-2.5)
	2020	18,855	-781	(-4.0)
	△ 77-2020	11,808	-781	(-6.2)
	% △	168%		
South	1977	14,406	-	-
	1985	21,375	-54	(-0.3)
	1990	26,514	-129	(-0.5)
	2000	29,618	-208	(-0.7)
	2020	29,270	-270	(-0.9)
	△ 77-2020	14,864	-270	(-1.8)
	% △	103%		
Total Region	1977	21,453	-	-
	1985	32,163	-135	(-0.4)
	1990	38,212	-388	(-1.0)
	2000	43,996	-583	(-1.3)
	2020	48,125	-1,051	(-2.1)
	△ 77-2020	26,672	-1,051	(-3.8)
	% △	124%		

* All values rounded to nearest $1 million.

** Percent change from Baseline projections for same period.

Table VI-17: MANAGEMENT STRATEGY TWO (MS-2) REGIONAL ECONOMY - VALUE ADDED, BY AGRICULTURALLY RELATED SECTORS WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 Dollars)*

Region	Year	MS-2	(%)**	Difference	(%)***
North	1977	2,573	(36.5)	-	-
	1985	4,237	(39.3)	-65	(-1.5)
	1990	4,531	(38.7)	-216	(-4.6)
	2000	5,994	(41.7)	-316	(-5.0)
	2020	8,222	(43.6)	-692	(-7.8)
	△ 77-2020	5,649	(47.8)	-692	(-10.9)
	% △	220%			
South	1977	1,669	(11.6)	-	-
	1985	2,091	(9.8)	-44	(-2.1)
	1990	2,179	(7.9)	-103	(-4.5)
	2000	2,875	(9.7)	-167	(-5.5)
	2020	3,711	(12.7)	-197	(-5.0)
	△ 77-2020	2,042	(13.7)	-197	(-8.8)
	% △	122%			
Total Region	1977	4,242	(19.8)	-	-
	1985	6,328	(19.7)	-109	(-1.7)
	1990	6,710	(17.6)	-319	(-4.5)
	2000	8,869	(20.2)	-483	(-5.2)
	2020	11,933	(24.8)	-889	(-6.9)
	△ 77-2020	7,691	(28.8)	-889	(-10.4)
	% △	181%			

* All values rounded to nearest $1 million.

** Agriculturally related value added as a percentage of Total Value Added.

*** Percentage change from Baseline to MS-2 projections.

Table VI-18: MANAGEMENT STRATEGY TWO (MS-2) REGIONAL ECONOMY - TOTAL EMPLOYMENT, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1000's of Full Time Job Equivalents)*

Region	Year	MS-2	Difference	(%)**
North	1977	444.2	-	-
	1985	534.1	-4.7	(-0.9)
	1990	520.7	-12.6	(-2.4)
	2000	523.3	-13.7	(-2.6)
	2020	531.1	-23.6	(-4.3)
	△ 77-2020	86.9	-23.6	(-21.5)
	% △	20%		
South	1977	563.6	-	-
	1985	652.8	-3.9	(-0.6)
	1990	695.6	-7.7	(-1.1)
	2000	785.8	-8.8	(-1.1)
	2020	770.2	-8.2	(-1.1)
	△ 77-2020	206.6	-8.2	(-3.8)
	% △	37%		
Total Region	1977	1,007.8	-	-
	1985	1,186.9	-8.6	(-0.7)
	1990	1,216.3	-20.3	(-1.6)
	2000	1,309.1	-22.5	(-1.7)
	2020	1,301.2	-32.0	(-2.4)
	△ 77-2020	293.4	-32.0	(-9.8)
	% △	29%		

* All values rounded to nearest 0.1 thousand jobs.

** Percentage change from Baseline to MS-2 projections.

Table VI-18.1: MANAGEMENT STRATEGY TWO (MS-2) REGIONAL ECONOMY - TOTAL HOUSEHOLD INCOME FROM ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions of 1977 Dollars)*

Region	Year	MS-2	Difference	(%)**
North	1977	4,909	-	-
	1985	7,009	-50	(-0.7)
	1990	7,562	-156	(-2.0)
	2000	9,512	-227	(-2.3)
	2020	12,926	-430	(-3.2)
	△ 77-2020	8,017	-430	(-5.1)
	% △	163%		
South	1977	7,575	-	-
	1985	11,114	-46	(-0.4)
	1990	14,053	-112	(-0.8)
	2000	18,628	-187	(-1.0)
	2020	23,308	-249	(-1.1)
	△ 77-2020	15,733	-249	(-1.6)
	% △	208%		
Total Region	1977	12,484	-	-
	1985	18,123	-96	(-0.5)
	1990	21,615	-268	(-1.2)
	2000	28,140	-414	(-1.5)
	2020	36,235	-678	(-1.8)
	△ 77-2020	23,751	-678	(-2.8)
	% △	190%		

* Values rounded to nearest $1 million.

** Percentage change from Baseline to MS-2 projections.

Table VI-19: MANAGEMENT STRATEGY TWO (MS-2) - POPULATION PROJECTIONS, BY SUBREGION AND REGION, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 TO 2020 (1000's of Persons)*

Subregion Region	Year	MS-2	Change	(%)**
North	1977	903	-	-
	1985	1,085	-8	(-0.7)
	1990	1,057	-27	(-2.5)
	2000	1,063	-28	(-2.6)
	2020	1,077	-51	(-4.5)
	△77-2020	174		
	% △	19%		
South	1977	1,268	-	-
	1985	1,475	-9	(-0.6)
	1990	1,577	-18	(-1.1)
	2000	1,790	-21	(-1.2)
	2020	1,769	-18	(-1.0)
	△77-2020	501		
	% △	40%		
Total Region	1977	2,171	-	-
	1985	2,560	-17	(-0.7)
	1990	2,634	-45	(-1.7)
	2000	2,853	-49	(-1.7)
	2020	2,844	-71	(-2.4)
	△77-2020	673		
	% △	31%		

* All values rounded to nearest 1 thousand persons.

** Percent change from Baseline projection for same period.

Table VI-20: MANAGEMENT STRATEGY TWO (MS-2) - AVERAGE PER CAPITA INCOME*, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE PROJECTIONS (1977 Dollars)**

Subregion/ Region	Year	MS-2	Change	(%)***
North	1977	5,436	-	-
	1985	6,460	2	-
	1990	7,154	34	(0.5)
	2000	8,948	21	(0.2)
	2020	12,002	162	(1.4)
	△ 77-2020	6,566	162	(2.5)
	% △	121%		
South	1977	5,974	-	-
	1985	7,535	15	(0.2)
	1990	8,911	30	(0.3)
	2000	10,407	18	(0.2)
	2020	13,176	-6	-
	△ 77-2020	7,202	-6	(-0.1)
	% △	121%		
Total Region	1977	5,750	-	-
	1985	7,079	9	(0.1)
	1990	8,206	38	(0.5)
	2000	9,863	24	(0.2)
	2020	12,741	78	(0.6)
	△ 77-2020	6,991	78	(1.1)
	% △	122%		

* Average Per Capita Income is Total Household Income divided by Population.

** All values rounded to nearest $1.

*** Percent changes from Baseline projections.

Table VI-21: MANAGEMENT STRATEGY TWO (MS-2) REGIONAL ECONOMY - STATE AND LOCAL GOVERNMENT REVENUE PROJECTIONS FROM ALL SECTORS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 Dollars)*

Region	Year	MS-2	Difference (%)**	
North	1977	308.4	-	-
	1985	495.7	-2.6	(-0.5)
	1990	530.6	-8.6	(-1.6)
	2000	621.8	-13.1	(-2.1)
	2020	815.7	-30.4	(-3.6)
	△ 77-2020	507.3	-30.4	(-5.7)
	% △	164%		
South	1977	564.6	-	-
	1985	726.5	-1.5	(-0.2)
	1990	974.2	-3.3	(-0.3)
	2000	836.4	-3.6	(-0.4)
	2020	544.2	-3.5	(-0.6)
	△ 77-2020	-20.4	-3.5	(-20.7)
	% △	-4%		
Total Region	1977	872.9	-	-
	1985	1,222.3	-4.0	(-0.3)
	1990	1,504.8	-11.9	(-0.8)
	2000	1,458.2	-16.7	(-1.1)
	2020	1,359.9	-33.9	(-2.4)
	△ 77-2020	487.0	-33.9	(-6.5)
	% △	56%		

* All values rounded to nearest $0.1 million.

** Percentage change from Baseline to MS-2 projections.

MANAGEMENT STRATEGY FIVE-A

(MS-5A)

Table VI-22: MANAGEMENT STRATEGY FIVE-A (MS-5A) - ANNUAL WATER USE RATES BY STATE, SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE FOR 2000 to 2020 (1000 Acre-Feet per Year)*

State	Year	MS-5A	Change	(%)**
Colorado	1977	1,150	--	--
	1985	--	--	--
	1990	--	--	--
	2000	1,140	175	(18.1)
	2020	1,035	380	(58.0)
	△ 77-2020	-115	380	(76.8)
	% △	-10%		
Kansas	1977	3,280	--	--
	1985	--	--	--
	1990	--	--	--
	2000	2,290	1,275	(125.6)
	2020	2,415	1,590	(192.7)
	△ 77-2020	-865	1,590	(64.8)
	% △	-26%		
Nebraska	1977	7,835	--	--
	1985	--	--	--
	1990	--	--	--
	2000	13,285	320	(2.5)
	2020	16,670	1,870	(12.6)
	△ 77-2020	8,835	1,870	(26.8)
	% △	113%		
New Mexico	1977	965	--	--
	1985	--	--	--
	1990	--	--	--
	2000	915	90	(10.9)
	2020	855	300	(54.1)
	△ 77-2020	-110	300	(73.2)
	% △	-11%		
Oklahoma	1977	670	--	--
	1985	--	--	--
	1990	--	--	--
	2000	1,030	235	(29.6)
	2020	930	110	(13.4)
	△ 77-2020	260	110	(73.3)
	% △	39%		
Texas	1977	8,240	--	--
	1985	--	--	--
	1990	--	--	--
	2000	3,705	130	(3.6)
	2020	3,460	225	(7.0)
	△ 77-2020	-4,780	225	(4.5)
	% △	-58%		

Subregions/Region

North

Year	MS-5A	Change	(%)**
1977	12,265	--	--
1985	--	--	--
1990	--	--	--
2000	16,715	1,770	(11.8)
2020	20,120	3,840	(23.6)
△ 77-2020	7,855	3,840	(95.6)
% △	64%		

South

Year	MS-5A	Change	(%)**
1977	9,875	--	--
1985	--	--	--
1990	--	--	--
2000	5,650	455	(8.8)
2020	5,245	635	(13.8)
△ 77-2020	-4,630	635	(12.1)
% △	47%		

Total Region

Year	MS-5A	Change	(%)**
1977	22,140	--	--
1985	--	--	--
1990	--	--	--
2000	22,365	2,225	(11.0)
2020	25,365	4,475	(21.4)
△ 77-2020	3,225	4,475	(358.0)
% △	15%		

* All values rounded to nearest 5 thousand acre-feet.

** Percentage change from Baseline projections for same period. Dashes indicate no change.

Table VI-23: MANAGEMENT STRATEGY FIVE-A (MS-5A) - CROPLAND ACRES - IRRIGATED, DRYLAND AND TOTALS, BY STATE WITH COMPARISON TO BASELINE PROJECTIONS FOR 2000 to 2020 (1000 Acres)*

State	Year	MS-5A			Differences (%)**					
		Irr.	Dry	Total	Irr.	(%)	Dry	(%)	Total	(%)
Colorado	1977	600	1,685	2,285	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	630	1,685	2,315	130	(26.0)	-65	(-3.7)	65	(2.9)
	2020	630	1,685	2,315	265	(72.6)	-130	(-7.2)	135	(6.2)
	△ 77-2020	30	0	30	265	(112.8)	-130	(-103.8)	135	(128.6)
	% △	5%	-	1%						
Kansas	1977	2,180	3,965	6,145	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	1,710	5,970	7,680	950	(125.0)	-75	(-1.2)	875	(12.9)
	2020	2,010	6,040	8,050	1,430	(246.6)	-410	(-6.4)	1,020	(14.5)
	△ 77-2020	-170	2,075	1,905	1,430	(89.4)	-410	(-16.5)	1,020	(115.3)
	% △	8%	52%	31%						
Nebraska	1977	4,700	5,945	10,645	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	11,040	3,210	14,250	1,220	(12.4)	-450	(-12.3)	770	(5.7)
	2020	13,640	2,120	15,760	2,175	(19.0)	-1,440	(-40.4)	735	(4.9)
	△ 77-2020	8,940	-3,825	5,115	2,175	(32.2)	-1,440	(-60.4)	735	(16.8)
	% △	190%	64%	48%						
New Mexico	1977	440	505	945	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	470	520	990	115	(32.4)	-95	(-16.1)	20	(2.1)
	2020	480	520	1,000	235	(95.9)	-210	(-28.8)	25	(2.6)
	△ 77-2020	40	15	55	235	(120.5)	-210	(-93.3)	25	(83.3)
	% △	9%	3%	6%						
Oklahoma	1977	395	1,355	1,750	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	660	1,050	1,710	245	(59.0)	-290	(-21.6)	-45	(-2.6)
	2020	700	1,020	1,720	250	(55.6)	-285	(-21.8)	-35	(-2.0)
	△ 77-2020	305	-335	-30	250	(416.7)	-285	(-570.0)	-35	(-700.0)
	% △	77%	25%	2%						
Texas	1977	5,970	4,815	10,785	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	6,140	4,630	10,770	640	(11.6)	-565	(-11.0)	75	(0.6)
	2020	6,140	4,620	10,760	1,200	(24.3)	-1,070	(-18.8)	130	(1.2)
	△ 77-2020	170	-195	-25	1,200	(116.5)	-1,070	(-122.3)	130	(83.9)
	% △	3%	4%	-						

* All values rounded to nearest 5 thousand acres.

** Percent change from Baseline projections.

Table VI-23.1: MANAGEMENT STRATEGY FIVE-A (MS-5A) - CROPLAND ACRES - IRRIGATED, DRYLAND AND TOTALS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 2000 to 2020 (1000 Acres)*

Subregion Region	Year	MS-5A			Differences (%)**					
		Irr.	Dry	Total	Irr.	(%)	Dry	(%)	Total	(%)
North	1977	7,480	11,595	19,075	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	13,380	10,865	24,245	2,300	(20.8)	-590	(-5.1)	1,710	(7.6)
	2020	16,280	9,845	26,125	3,870	(31.2)	-1,980	(-16.7)	1,890	(7.8)
	△77-2020	8,800	-1,750	7,050	3,870	(78.5)	-1,980	(-860.9)	1,890	(36.6)
	%△	118%	-15%	37%						
South	1977	6,805	6,675	13,480	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	7,270	6,200	13,470	1,000	(15.9)	-950	(-13.4)	50	(0.4)
	2020	7,320	6,160	13,480	1,685	(29.9)	-1,565	(-20.3)	120	(0.9)
	△77-2020	515	-515	0	1,685	(144.0)	-1,565	(-148.6)	120	(100.0)
	%△	8%	8%	-						
Total Region	1977	14,285	18,270	32,555	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	20,650	17,065	37,715	3,300	(19.1)	-1,540	(-8.3)	1,760	(4.9)
	2020	23,600	16,005	39,605	5,555	(30.7)	-3,545	(-18.1)	2,010	(5.3)
	△77-2020	9,320	-2,265	7,055	5,555	(147.7)	-3,545	(277.0)	2,010	(39.9)
	%△	65%	-12%	22%						

* All values rounded to nearest 5 thousand acres.

** Percent change from Baseline projection.

Table VI-24: MANAGEMENT STRATEGY FIVE-A (MS-5A) - CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS FOR 2000 TO 2020 (Millions of Bushels)*

State	Year	Wheat	(%)**	Corn	(%)**	Sorghum	(%)**
Colorado	1977	36.9	-	56.4	-	6.5	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	47.6	(-3.1)	82.4	(19.6)	6.4	(68.4)
	2020	57.7	(-10.6)	87.2	(78.0)	2.9	(11.5)
	△77-2020	20.8	(-24.6)	30.8	(516.2)	-3.6	(-7.7)
	%△	56%		55%		-55%	
Kansas	1977	127.8	-	91.3	-	37.4	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	197.5	(-0.9)	145.7	(494.7)	70.3	(-0.7)
	2020	248.2	-	160.8	(484.7)	88.1	(-7.4)
	△77-2020	120.4	-	69.5	(208.9)	50.7	(-12.1)
	%△	94%		76%		136%	
Nebraska	1977	79.7	-	539.0	-	108.0	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	50.9	(-10.9)	1,344.6	(4.5)	110.7	(-9.3)
	2020	45.3	(-25.5)	1,815.4	(11.9)	107.0	(-30.2)
	△77-2020	-34.4	(-82.0)	1,276.4	(17.9)	-1.0	(-102.2)
	%△	43%		237%		-1%	
New Mexico	1977	9.4	-	12.4	-	11.8	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	15.1	(-1.9)	23.6	(36.4)	18.6	(43.1)
	2020	20.0	(-2.9)	26.6	(98.5)	18.5	(180.3)
	△77-2020	10.6	(-5.4)	14.2	(1,320.0)	-6.7	(228.8)
	%△	113%		115%		-57%	
Oklahoma	1977	22.8	-	6.4	-	14.6	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	26.4	(-16.6)	19.7	(62.8)	41.8	(51.4)
	2020	35.3	(-17.3)	23.2	(67.8)	48.1	(50.3)
	△77-2020	12.5	(-37.2)	16.8	(102.4)	33.5	(91.4)
	%△	55%		263%		229%	
Texas	1977	50.9	-	157.3	-	121.4	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	29.9	(-7.1)	21.4	(9.2)	178.2	(-1.3)
	2020	30.1	(-14.0)	13.7	(20.2)	187.0	(-2.1)
	△77-2020	-20.8	(-30.8)	-143.6	(1.6)	65.6	(-5.7)
	%△	-41%		-91%		54%	

* All values rounded to nearest 0.1 million bushels.

** Percent change (increase or decrease) from Baseline projections for same period. Table VI-24 continued on following page.

Table VI-24: MANAGEMENT STRATEGY FIVE-A (MS-5A) - CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS (Millions of Bushels) (Cont'd)*

State	Year	Soybeans (Million Bushels)	(%)**	Alfalfa (1000 Tons)	(%)**	Cotton (1000 Bales)	(%)**
Colorado	1977	0.0	-	180	-	0	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	0.0	-	232	(33.3)	0	-
	2020	0.0	-	248	(81.0)	0	-
	△ 77-2020	0.0	-	68	(258.1)	0	-
	% △	-		38%		-	
Kansas	1977	0.6	-	999	-	0	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	7.1	(69.0)	1,459	(6.5)	0	-
	2020	15.9	(205.8)	1,842	(34.7)	0	-
	△ 77-2020	15.3	(232.6)	843	(129.1)	0	-
	% △	255%		84%		-	
Nebraska	1977	8.5	-	3,315	-	-	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	109.0	(1.3)	3,614	(-2.8)	0	-
	2020	168.9	(4.7)	3,388	(-10.7)	0	-
	△ 77-2020	160.4	(5.0)	73	(-84.8)	0	-
	% △	189%		2%		-	
New Mexico	1977	0.0	-	243	-	42	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	0.0	-	531	(7.1)	55	(14.6)
	2020	0.0	-	727	(47.8)	52	(-5.5)
	△ 77-2020	0.0	-	484	(94.4)	10	(-23.1)
	% △	-		199%		24%	
Oklahoma	1977	0.0	-	230	-	0	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	0.0	-	425	(46.6)	0	-
	2020	0.0	-	422	(42.6)	0	-
	△ 77-2020	0.0	-	192	(190.9)	0	-
	% △	-		83%		-	
Texas	1977	5.4	-	546	-	2,916	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	9.1	(15.2)	762	(12.6)	6,249	(9.7)
	2020	4.1	(20.6)	1,075	(27.1)	7,051	(19.8)
	△ 77-2020	-1.3	(35.0)	529	(76.3)	4,135	(39.2)
	% △	-24%		97%		142%	

* Soybean values rounded to nearest 0.1 million bushel; alfalfa to nearest 1 thousand tons; and cotton to nearest 1 thousand bales.

** Percent change (increase or decrease) from Baseline projection for same period.

Table VI-24.1: MANAGEMENT STRATEGY FIVE-A (MS-5A) - CROP PRODUCTION FOR SIX MAJOR CROPS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE PROJECTIONS FOR 2000 to 2020*

Subregion/ Region	Year	Wheat	(%)**	Corn	(%)**	Sorghum	(%)**	Soybean	(%)**	Alfalfa	(%)**	Cotton	(%)**
		Millions of Bushels								(1000 Tons)		(1000 Bales)	
North	1977	244.4	-	686.7	-	151.9	-	9.2	-	4,494	-	0	-
	1985	-	-	-	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-	-	-	-
	2000	296.0	(-3.1)	1,572.7	(14.0)	187.4	(-4.7)	116.1	(3.8)	5,305	(0.8)	0	-
	2020	351.2	(-6.0)	2,063.4	(21.5)	198.0	(-21.1)	184.8	(11.0)	5,478	(3.4)	0	-
	△ 77-2020	106.8	(-17.3)	1,376.7	(35.1)	46.1	(-53.5)	175.6	(11.7)	984	(25.0)	0	-
	% △	44%		200%		30%		1,909%		22%		-	
South	1977	83.1	-	176.1	-	147.8	-	5.4	-	1,019	-	2,958	-
	1985	-	-	-	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-	-	-	-
	2000	71.4	(-9.8)	64.7	(32.0)	238.6	(7.9)	9.1	(15.2)	1,718	(17.4)	6,304	(9.7)
	2020	85.4	(-13.1)	63.5	(60.8)	253.6	(10.5)	4.1	(20.6)	2,224	(36.1)	7,103	(19.5)
	△ 77-2020	2.3	(-84.9)	-112.6	(17.6)	105.8	(29.3)	-1.3	(35.0)	1,205	(100.1)	4,145	(38.9)
	% △	3%		-64%		72%		-24%		118%		140%	
Region	1977	327.5	-	862.7	-	299.7	-	14.6	-	5,513	-	2,958	-
	1985	-	-	-	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-	-	- 1	-
	2000	367.4	(-4.5)	1,637.4	(14.6)	426.0	(2.0)	125.2	(4.6)	7,023	(4.4)	6,304	(9.7)
	2020	436.6	(-7.5)	2,126.9	(22.4)	451.6	(-6.0)	188.9	(11.2)	7,702	(11.1)	7,103	(19.5)
	△ 77-2020	109.1	(-24.4)	1,264.1	(44.4)	151.9	(-16.1)	174.3	(12.3)	2,189	(57.1)	4,145	(38.9)
	% △	33%		147%		51%		1,194%		40%		140%	

* Wheat, corn, sorghum and soybean values rounded to nearest 0.1 million bushels; alfalfa to nearest 1 thousand tons; and cotton to nearest 1 thousand bales.

** Percent change from Baseline Projection for same period.

Table VI-25: MANAGEMENT STRATEGY FIVE-A (MS-5A) - VALUE OF AGRICULTURAL PRODUCTION, BY STATE, SUBREGION AND REGIONAL TOTALS WITH COMPARISON TO BASELINE FOR 2000 TO 2020 (Millions 1977 $)*

State	Year	MS-5A	Change	(%)**
Colorado	1977	275	--	--
	1985	--	--	--
	1990	--	--	--
	2000	430	45	(11.7)
	2020	510	115	(29.1)
	△ 77-2020	235	115	(95.8)
	% △	85%		
Kansas	1977	655	--	--
	1985	--	--	--
	1990	--	--	--
	2000	1,275	340	(36.4)
	2020	1,730	470	(37.3)
	△ 77-2020	1,075	470	(77.7)
	% △	164%		
Nebraska	1977	1,680	--	--
	1985	--	--	--
	1990	--	--	--
	2000	5,170	405	(8.5)
	2020	7,150	695	(10.8)
	△ 77-2020	5,470	695	(14.6)
	% △	322%		
New Mexico	1977	125	--	--
	1985	--	--	--
	1990	--	--	--
	2000	245	35	(16.7)
	2020	310	90	(40.9)
	△ 77-2020	185	90	(94.7)
	% △	148%		
Oklahoma	1977	130	--	--
	1985	--	--	--
	1990	--	--	--
	2000	290	45	(18.4)
	2020	365	40	(12.3)
	△ 77-2020	235	40	(20.5)
	% △	181%		
Texas	1977	1,705	--	--
	1985	--	--	--
	1990	--	--	--
	2000	2,775	140	(5.3)
	2020	3,140	305	(10.8)
	△ 77-2020	1,435	305	(27.0)
	% △	84%		

Subregions/Region

North

Year	MS-5A	Change	(%)**
1977	2,610	--	--
1985	--	--	--
1990	--	--	--
2000	6,880	790	(13.0)
2020	9,385	1,275	(15.7)
△77-2020	6,775	1,275	(23.2)
% △	260%		

South

Year	MS-5A	Change	(%)**
1977	1,960	--	--
1985	--	--	--
1990	--	--	--
2000	3,310	215	(6.9)
2020	3,815	430	(12.7)
△ 77-2020	1,855	430	(30.2)
% △	95%		

Total Region

Year	MS-5A	Change	(%)**
1977	4,570	--	--
1985	--	--	--
1990	--	--	--
2000	10,190	1,005	(10.9)
2020	13,200	1,705	(14.8)
△ 77-2020	8,630	1,705	(24.6)
% △	189%		

* All values rounded to nearest $5 million. Values at subregional and regional levels may not be additive from state totals due to rounding.

** Percent change from Baseline projection.

Table VI-26: MANAGEMENT STRATEGY FIVE-A (MS-5A) - - RETURNS TO LAND AND MANAGEMENT BY STATE, SUBREGION AND REGIONAL TOTALS WITH COMPARISON TO BASELINE FOR 2000 TO 2020 (Millions 1977 $)*

State	Year	MS-5A	Change	(%)**
Colorado	1977	90	--	--
	1985	--	--	--
	1990	--	--	--
	2000	150	30	(25.0)
	2020	215	55	(34.4)
	Δ 77-2020	125	57	(78.6)
	% Δ	139%		
Kansas	1977	210	--	--
	1985	--	--	--
	1990	--	--	--
	2000	710	160	(29.1)
	2020	1,070	215	(25.1)
	Δ 77-2020	860	215	(33.3)
	% Δ	410%		
Nebraska	1977	555	--	--
	1985	--	--	--
	1990	--	--	--
	2000	2,190	160	(7.9)
	2020	3,255	280	(9.4)
	Δ 77-2020	2,700	280	(11.6)
	% Δ	486%		
New Mexico	1977	25	--	--
	1985	--	--	--
	1990	--	--	--
	2000	110	20	(22.7)
	2020	165	50	(43.1)
	Δ 77-2020	140	50	(55.5)
	% Δ	560%		
Oklahoma	1977	30	--	--
	1985	--	--	--
	1990	--	--	--
	2000	65	15	(30.0)
	2020	90	20	(28.6)
	Δ 77-2020	60	20	(50.0)
	% Δ	200%		
Texas	1977	145	--	--
	1985	--	--	--
	1990	--	--	--
	2000	610	45	(8.0)
	2020	840	105	(14.3)
	Δ 77-2020	695	105	(17.8)
	% Δ	479%		

Subregions/Region

Year	MS-5A	Change	(%)**
1977	850	--	--
1985	--	--	--
1990	--	--	--
2000	3,050	350	(13.0)
2020	4,540	550	(13.8)
Δ77-2020	3,690	550	(17.5)
% Δ	434%		

South

Year	MS-5A	Change	(%)**
1977	200	--	--
1985	--	--	--
1990	--	--	--
2000	785	85	(12.1)
2020	1,100	180	(19.6)
Δ77-2020	900	180	(25.0)
% Δ	450%		

Total Region

Year	MS-5A	Change	(%)**
1977	1,050	--	--
1985	--	--	--
1990	--	--	--
2000	3,835	430	(12.6)
2020	5,640	730	(14.9)
Δ77-2020	4,590	730	(19.0)
% Δ	437%		

Note: Pavment of charges for imported water would have to be made from the increase in returns

* All values rounded to nearest $5 million.

** Percent change from Baseline projection.

Table VI-27: MANAGEMENT STRATEGY FIVE-A (MS-5A) REGIONAL ECONOMY - TOTAL VALUE ADDED, ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 Dollars)*

Region	Year	MS-5A	Difference	(%)**
North	1977	7,047	-	-
	1985	-	-	-
	1990	-	-	-
	2000	15,552	799	(5.4)
	2020	21,162	1,526	(7.8)
	△ 77-2020	14,115	1,526	(12.1)
	% △	200%		
South	1977	14,406	-	-
	1985	-	-	-
	1990	-	-	-
	2000	30,024	198	(0.7)
	2020	30,011	471	(1.6)
	△ 77-2020	15,605	471	(3.1)
	% △	108%		
Total Region	1977	21,453	-	-
	1985	-	-	-
	1990	-	-	-
	2000	45,576	997	(2.2)
	2020	51,173	1,997	(4.1)
	△ 77-2020	29,720	1,997	(7.2)
	% △	139%		

* All values rounded to nearest $1 million.

** Percent change from Baseline projection for same period.

Table VI-28: MANAGEMENT STRATEGY FIVE-A (MS-5A) REGIONAL ECONOMY - VALUE ADDED, BY AGRICULTURAL RELATED SECTORS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 $)*

Subregion/ Region	Year	MS-5A	(%)**	Change	(%)***
North	1977	2,573	(36.5)	-	-
	1985	-	-	-	-
	1990	-	-	-	-
	2000	7,035	(45.2)	725	(11.5)
	2020	10,272	(48.5)	1,358	(15.2)
	△ 77-2020	7,699	(54.5)	1,358	(21.4)
	% △	299%			
South	1977	1,669	(11.6)	-	-
	1985	-	-	-	-
	1990	-	-	-	-
	2000	3,194	(10.6)	152	(5.0)
	2020	4,244	(14.1)	336	(8.6)
	△ 77-2020	2,575	(16.5)	336	(15.0)
	% △	154%			
Total Region	1977	4,242	(19.8)	-	-
	1985	-	-	-	-
	1990	-	-	-	-
	2000	10,229	(22.4)	877	(9.4)
	2020	14,516	(28.4)	1,694	(13.2)
	△ 77-2020	10,274	(34.6)	1,694	(19.7)
	% △	242%			

* All values rounded to nearest $1 million.

** Agriculturally related value as a percentage of Total Value Added (Table VI-27)

*** Percentage change from Baseline.

Table VI-29: MANAGEMENT STRATEGY FIVE-A (MS-5A) REGIONAL ECONOMY - TOTAL EMPLOYMENT, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1000's of Jobs)*

Subregion/ Region	Year	MS-5A	Difference	(%)**
North	1977	444.2	-	-
	1985	-	-	-
	1990	-	-	-
	2000	568.0	31.0	(5.8)
	2020	604.0	49.3	(8.9)
	△ 77-2020	159.8	49.3	(44.6)
	% △	36%		
South	1977	563.6	-	-
	1985	-	-	-
	1990	-	-	-
	2000	802.6	8.0	(1.0)
	2020	792.6	14.2	(1.8)
	△ 77-2020	229.0	14.2	(6.6)
	% △	41%		
Total Region	1977	1,007.8	-	-
	1985	-	-	-
	1990	-	-	-
	2000	1,370.6	39.0	(2.9)
	2020	1,396.6	63.4	(4.8)
	△ 77-2020	388.8	63.4	(19.5)
	% △	39%		

* All values rounded to nearest 0.1 thousand full time job equivalents.

** Percentage change from Baseline projections for each period.

Table VI-29.1: MANAGEMENT STRATEGY FIVE-A (MS-5A) REGIONAL ECONOMY - TOTAL HOUSEHOLD INCOME FROM ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (MILLIONS OF DOLLARS)*

Subregion/ Region	Year	MS-5A	Difference	(%)**
North	1977	4,909	-	-
	1985	-	-	-
	1990	-	-	-
	2000	10,225	486	(5.0)
	2020	14,273	917	(6.9)
	△ 77-2020	9,364	917	(10.9)
	% △	191%		
South	1977	7,575	-	-
	1985	-	-	-
	1990	-	-	-
	2000	18,991	176	(0.9)
	2020	23,984	427	(1.8)
	△ 77-2020	16,409	427	(2.7)
	% △	217%		
Total Region	1977	12,484	-	-
	1985	-	-	-
	1990	-	-	-
	2000	29,216	662	(2.3)
	2020	38,257	1,344	(3.6)
	△ 77-2020	25,773	1,344	(5.5)
	% △	206%		

* All values rounded to nearest $1 million.

** Percentage change from Baseline projections for each period.

Table VI-30: MANAGEMENT STRATEGY FIVE-A (MS-5A) REGIONAL ECONOMY - POPULATION PROJECTIONS BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1000's of Persons)*

Subregion/ Region	Year	MS-5A	Change	(%)**
North	1977	903	-	-
	1985	-	-	-
	1990	-	-	-
	2000	1,155	64	(5.9)
	2020	1,228	100	(8.9)
	Δ 77-2020	325	100	(44.4)
	% Δ	36%		
South	1977	1,268	-	-
	1985	-	-	-
	1990	-	-	-
	2000	1,830	19	(1.0)
	2020	1,821	34	(1.9)
	Δ 77-2020	553	34	(6.6)
	% Δ	44%		
Total Region	1977	2,171	-	-
	1985	-	-	-
	1990	-	-	-
	2000	2,985	83	(2.9)
	2020	3,049	134	(4.6)
	Δ 77-2020	878	134	(18.0)
	% Δ	40%		

* All values rounded to nearest 1 thousand persons.
** Percentage change from Baseline projection for each period.

Table VI-31: MANAGEMENT STRATEGY FIVE-A (MS-5A) REGIONAL ECONOMY - AVERAGE PER CAPITA INCOME*, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1977 $)**

Subregion/ Region	Year	MS-5A	Change	(%)***
North	1977	5,436	-	-
	1985	-	-	-
	1990	-	-	-
	2000	8,853	-74	(-0.8)
	2020	11,623	-217	(-1.8)
	△ 77-2020	6,187	-217	(-3.4)
	% △	114%		
South	1977	5,974	-	-
	1985	-	-	-
	1990	-	-	-
	2000	10,378	-11	(-0.1)
	2020	13,171	-11	(-0.1)
	△ 77-2020	7,197	-11	(-0.2)
	% △	120%		
Total Region	1977	5,750	-	-
	1985	-	-	-
	1990	-	-	-
	2000	9,788	-51	(-0.5)
	2020	12,547	-116	(-0.9)
	△ 77-2020	6,797	-116	(-1.7)
	% △	118%		

* Average Per Capita Income is Total Household Income divided by Population.

** All values rounded to nearest $1.

*** Percentage change from Baseline.

Table VI-32: MANAGEMENT STRATEGY FIVE-A (MS-5A) REGIONAL ECONOMY - STATE AND LOCAL GOVERNMENT REVENUE GROWTH FROM ALL SECTORS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 Dollars)*

Subregion/ Region	Year	MS-5A	Difference (%)**	
North	1977	308.4	-	-
	1985	-	-	-
	1990	-	-	-
	2000	661.8	26.9	(4.3)
	2020	896.8	50.7	(6.0)
	△ 77-2020	588.4	50.7	(9.4)
	% △	191%		
South	1977	564.6	-	-
	1985	-	-	-
	1990	-	-	-
	2000	844.1	4.1	(0.5)
	2020	555.3	7.6	(1.4)
	△ 77-2020	-9.3	7.6	(45.0)
	% △	-2%		
Total Region	1977	872.9	-	-
	1985	-	-	-
	1990	-	-	-
	2000	1,505.9	31.0	(2.1)
	2020	1,452.1	58.3	(4.2)
	△ 77-2020	579.2	58.3	(11.2)
	% △	66%		

* All values rounded to nearest $0.1 million.

** Percentage change from Baseline projection for each period.

MANAGEMENT STRATEGY FIVE-B

(MS-5B)

Table VI-33: MANAGEMENT STRATEGY FIVE-B (MS-5B) - ANNUAL WATER USE RATES BY STATE, SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE FOR 2000 to 2020 (1000 Acre-Feet per Year)*

State	Year	MS-5B	Change	(%)**
Colorado	1977	1,150	--	--
	1985	--	--	--
	1990	--	--	--
	2000	870	-95	(-9.8)
	2020	760	105	(16.0)
	△ 77-2020	-390	105	(21.4)
	% △	-34%		
Kansas	1977	3,280	--	--
	1985	--	--	--
	1990	--	--	--
	2000	1,700	685	(67.5)
	2020	1,750	925	(112.1)
	△ 77-2020	-1,530	925	(37.8)
	% △	-47%		
Nebraska	1977	7,835	--	--
	1985	--	--	--
	1990	--	--	--
	2000	9,320	-3,645	(-28.1)
	2020	11,415	-3,385	(-22.9)
	△ 77-2020	3,580	-3,385	(-48.6)
	% △	46%		
New Mexico	1977	965	--	--
	1985	--	--	--
	1990	--	--	--
	2000	715	-110	(-13.3)
	2020	685	130	(23.4)
	△ 77-2020	-280	130	(31.7)
	% △	-29%		
Oklahoma	1977	670	--	--
	1985	--	--	--
	1990	--	--	--
	2000	680	-115	(-14.5)
	2020	600	-220	(-26.8)
	△ 77-2020	-70	-220	(-146.7)
	% △	-10%		
Texas	1977	8,240	--	--
	1985	--	--	--
	1990	--	--	--
	2000	2,640	-935	(-26.2)
	2020	2,465	-770	(-23.8)
	△ 77-2020	-5,775	-770	(-15.5)
	% △	-70%		

Subregions/Region

North

Year	MS-5B	Change	(%)**
1977	12,265	--	--
1985	--	--	--
1990	--	--	--
2000	11,890	-3,055	(-20.4)
2020	13,925	-2,355	(-14.5)
△ 77-2020	1,660	-2,355	(-58.7)
% △	14%		

South

Year	MS-5B	Change	(%)**
1977	9,875	--	--
1985	--	--	--
1990	--	--	--
2000	4,035	-1,160	(-22.3)
2020	3,750	-860	(-18.7)
△ 77-2020	-6,125	-860	(-16.4)
% △	-62%		

Total Region

Year	MS-5B	Change	(%)**
1977	22,140	--	--
1985	--	--	--
1990	--	--	--
2000	15,925	-4,215	(-20.9)
2020	17,675	-3,215	(-15.4)
△ 77-2020	-4,465	-3,215	(-257.2)
% △	-20%		

* All values rounded to nearest 5 thousand acre-feet.

** Percent change from Baseline projection.

Table VI-35: MANAGEMENT STRATEGY FIVE-B (MS-5B) - CROPLAND ACRES - IRRIGATED, DRYLAND AND TOTALS, BY STATE WITH COMPARISON TO BASELINE PROJECTIONS FOR 2000 to 2020 (1000 Acres)*

State	Year	MS-5B Irr.	MS-5B Dry	MS-5B Total	Differences (%)** Irr.	(%)	Dry	(%)	Total	(%)
Colorado	1977	600	1,685	2,285	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	625	1,680	2,305	125	(25.0)	-70	(-4.0)	55	(2.4)
	2020	625	1,680	2,305	260	(71.2)	-135	(-7.4)	125	(5.7)
	△ 77-2020	25	-5	20	260	(110.6)	-135	(-103.8)	125	(119.0)
	% △	4%	-	1%						
Kansas	1977	2,180	3,965	6,145	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	1,290	6,060	7,350	530	(69.7)	15	(0.2)	545	(8.0)
	2020	1,400	6,190	7,590	820	(141.4)	-260	(-4.0)	560	(8.0)
	△ 77-2020	-780	2,225	1,445	820	(51.3)	-260	(-10.5)	560	(63.3)
	% △	36%	56%	24%						
Nebraska	1977	4,700	5,945	10,645	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	10,925	3,305	14,230	1,105	(11.3)	-355	(-9.7)	750	(5.6)
	2020	13,450	2,395	15,845	1,985	(17.3)	-1,165	(-32.7)	820	(5.5)
	△ 77-2020	8,750	-3,550	5,200	1,985	(29.3)	-1,165	(-48.8)	820	(18.7)
	% △	186%	-60%	49%						
New Mexico	1977	440	505	945	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	430	540	970	75	(21.1)	-75	(-12.2)	-	-
	2020	440	550	990	195	(79.6)	-180	(-24.7)	15	(1.5)
	△ 77-2020	0	45	45	195	(100.0)	-180	(-80.0)	15	(50.0)
	% △	-	9%	5%						
Oklahoma	1977	395	1,355	1,750	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	530	1,210	1,740	115	(27.7)	-130	(-9.7)	-15	(-0.9)
	2020	540	1,190	1,730	90	(20.0)	-115	(-8.8)	-25	(-1.4)
	△ 77-2020	145	-165	-20	90	(163.6)	-115	(230.0)	-25	(500.0)
	% △	37%	-12%	-1%						
Texas	1977	5,970	4,815	10,785	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	5,110	5,585	10,695	-390	(7.1)	390	(7.5)	-	-
	2020	5,040	5,615	10,655	100	(2.0)	-75	(-1.3)	-25	(0.2)
	△ 77-2020	-930	800	-130	100	(9.7)	-75	(-8.6)	25	(16.1)
	% △	-16%	17%	-1%						

* All values rounded to nearest 5 thousand acres.

** Percent change from Baseline projection.

Table VI-35.1: MANAGEMENT STRATEGY FIVE-B (MS-5B) - CROPLAND ACRES - IRRIGATED, DRYLAND AND TOTALS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 2000 to 2020 (1000 Acres)*

State	Year	MS-5B			Differences (%)**					
		Irr.	Dry	Total	Irr.	(%)	Dry	(%)	Total	(%)
North	1977	7,480	11,595	19,075	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	12,840	11,045	23,885	1,760	(15.9)	-410	(-3.6)	1,350	(6.0)
	2020	15,475	10,265	25,740	3,065	(24.7)	-1,560	(-13.2)	1,505	(6.2)
	Δ 77-2020	7,995	-1,330	6,665	3,065	(62.2)	-1,560	(-778.3)	1,505	(29.2)
	% Δ	107%	-11%	35%						
South	1977	6,805	6,675	13,480	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	6,070	7,330	13,400	-200	(-3.2)	180	(2.5)	20	(-0.1)
	2020	6,020	7,350	13,370	385	(6.8)	-375	(-4.9)	10	(0.1)
	Δ 77-2020	-785	675	-110	385	(32.9)	-375	(-35.7)	10	(8.3)
	% Δ	-12%	10%	-1%						
Total Region	1977	14,285	18,270	32,555	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-
	2000	18,910	18,375	37,285	1,560	(9.0)	-230	(-1.2)	1,330	(3.7)
	2020	21,495	17,615	39,110	3,450	(19.1)	-1,935	(-9.9)	1,515	(4.0)
	Δ 77-2020	7,210	-655	6,555	3,450	(91.8)	-1,935	(-251.2)	1,515	(30.1)
	% Δ	50%	-4%	20%						

* All values rounded to nearest 5 thousand acres.

** Percent change from Baseline projection.

Table VI-35.2: MANAGEMENT STRATEGY FIVE-B (MS-5B) - CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS FOR 2000 TO 2020 (Millions of Bushels)*

State	Year	Wheat	(%)**	Corn	(%)**	Sorghum	(%)**
Colorado	1977	36.9	-	56.4	-	6.5	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	47.7	(-2.9)	71.5	(3.8)	6.2	(63.2)
	2020	57.0	(-11.6)	58.0	(18.4)	2.5	(-3.8)
	△77-2020	20.1	(-27.2)	1.6	(121.6)	-4.0	(-2.6)
	% △	54%		3%		-62%	
Kansas	1977	127.8	-	91.3	-	37.4	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	208.1	(4.5)	99.0	(304.1)	70.3	(-0.7)
	2020	245.6	(-1.0)	112.0	(307.3)	89.1	(-6.3)
	△77-2020	117.8	(-2.2)	20.7	(132.4)	51.7	(-10.4)
	% △	92%		23%		138%	
Nebraska	1977	79.7	-	539.0	-	108.0	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	51.1	(-10.5)	1,143.9	(-11.1)	108.9	(-10.7)
	2020	47.0	(-22.7)	1,439.9	(-11.2)	216.8	(41.4)
	△77-2020	-32.7	(-73.0)	900.9	(-16.8)	108.8	(140.2)
	% △	-41%		167%		101%	
New Mexico	1977	9.4	-	12.4	-	11.8	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	15.1	(-1.9)	20.3	(17.3)	22.4	(72.3)
	2020	19.1	(-7.3)	21.7	(61.9)	18.2	(175.8)
	△77-2020	9.7	(-13.4)	9.3	(830.0)	6.4	(223.1)
	% △	103%		75%		54%	
Oklahoma	1977	22.8	-	6.4	-	14.5	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	28.0	(-11.4)	17.9	(47.9)	31.9	(15.6)
	2020	37.5	(-12.2)	20.3	(38.1)	35.7	(11.6)
	△77-2020	14.7	(-26.1)	13.9	(67.5)	21.2	(20.6)
	% △	64%		217%		146%	
Texas	1977	50.9	-	157.3	-	121.4	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	37.6	(16.8)	12.8	(-34.7)	134.0	(-25.8)
	2020	38.9	(11.1)	8.2	(-28.1)	142.2	(-25.5)
	△ 77-2020	-12.0	(24.5)	-149.1	(-2.2)	20.8	(-70.1)
	% △	24%		-95%		17%	

* Wheat, corn and sorghum values rounded to nearest 0.1 million bushels.

** Percent change (increase or decrease) from Baseline projection for same period. Table VI-35.2 continued on following page.

Table VI-35.2: MANAGEMENT STRATEGY FIVE-B (MS-5B) - CROP PRODUCTION FOR SIX MAJOR CROPS BY STATE, WITH COMPARISON TO BASELINE PROJECTIONS (Millions of Bushels) (Cont'd)*

State	Year	Soybeans (Million Bushels)	(%)**	Alfalfa (1000 Tons)	(%)**	Cotton (1000 Bales)	(%)**
Colorado	1977	0.0	-	180	-	0	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	0.0	-	82	(-52.9)	0	-
	2020	0.0	-	75	(-45.3)	0	-
	△77-2020	0.0	-	-105	(-144.2)	0	-
	%△	-		-58%		-	
Kansas	1977	0.6	-	999	-	0	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	6.6	(57.1)	1,340	(-2.2)	0	-
	2020	11.3	(117.3)	1,745	(27.7)	0	-
	△77-2020	10.7	(132.6)	746	(102.7)	0	-
	%△	1,783%		75%		-	
Nebraska	1977	8.5	-	3,315	-	-	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	109.7	(2.0)	3,406	(-8.4)	0	-
	2020	151.9	(-5.8)	3,265	(-14.0)	0	-
	△77-2020	143.4	(-6.2)	-50	(-110.4)	0	-
	%△	1,666%		-2%		-	
New Mexico	1977	0.0	-	243	-	42	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	0.0	-	173	(-65.1)	77	(60.4)
	2020	0.0	-	484	(-1.6)	77	(40.0)
	△77-2020	0.0	-	241	(-3.2)	35	(169.2)
	%△	-		99%		83%	
Oklahoma	1977	0.0	-	230	-	0	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	0.0	-	368	(26.9)	0	-
	2020	0.0	-	359	(21.3)	0	-
	△77-2020	0.0	-	129	(95.5)	0	-
	%△	-		56%		-	
Texas	1977	5.4	-	546	-	2,916	-
	1985	-	-	-	-	-	-
	1990	-	-	-	-	-	-
	2000	5.6	(-29.1)	604	(-10.8)	5,468	(-4.1)
	2020	4.2	(23.5)	674	(-20.3)	6,155	(4.6)
	△77-2020	-1.2	(40.0)	128	(-57.3)	3,239	(9.0)
	%△	-22%		23%		111%	

* Soybeans rounded to nearest 0.1 million bushels; alfalfa rounded to nearest one thousand tons; and cotton to nearest one thousand bales.

** Percent change (increase or decrease) from Baseline Projections for same period.

Table VI-35.3: MANAGEMENT STRATEGY FIVE-B (MS-5B) - CROP PRODUCTION FOR SIX MAJOR CROPS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISON TO BASELINE PROJECTIONS FOR 2000 to 2020*

Subregion/ Region	Year	Wheat	(%)**	Corn	(%)**	Sorghum	(%)**	Soybean	(%)**	Alfalfa	(%)**	Cotton	(%)**
		--------------------Millions of Bushels--------------------								(1000 Tons)		(1000 Bales)	
North	1977	244.4	-	686.6	-	151.9	-	9.2	-	4,494	-	0	-
	1985	-	-	-	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-	-	-	-
	2000	306.9	(0.5)	1,314.4	(-4.8)	185.4	(-5.7)	116.3	(4.0)	4,828	(-8.2)	0	-
	2020	349.6	(-6.4)	1,609.9	(-5.2)	308.4	(22.9)	163.2	(-2.0)	5,085	(-4.0)	0	-
	△77-2020	105.2	(-18.5)	923.3	(-8.8)	156.5	(57.9)	154.0	(-2.0)	591	(-25.0)	0	-
	% △	43%		134%		103%		1,674%		13%			
South	1977	83.1	-	176.1	-	147.8	-	5.4	-	1,019	-	2,958	-
	1985	-	-	-	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-	-	-	-
	2000	80.7	(1.9)	51.0	(4.1)	188.3	(-14.9)	5.6	(-29.1)	1,145	(-21.7)	5,545	(-3.5)
	2020	95.5	(-2.8)	50.2	(27.1)	196.1	(-14.6)	4.2	(23.5)	1,517	(-7.2)	6,232	(4.9)
	△77-2020	12.4	(-18.4)	-125.9	(7.8)	48.3	(-41.0)	-1.2	(40.0)	498	(-16.7)	3,274	(9.7)
	% △	15%		-71%		33%		-22%		49%		111%	
Region	1977	327.5	-	862.8	-	299.7	-	14.6	-	5,513	-	2,958	-
	1985	-	-	-	-	-	-	-	-	-	-	-	-
	1990	-	-	-	-	-	-	-	-	-	-	- 1	-
	2000	387.6	(0.8)	1,365.4	(-4.5)	373.7	(-10.6)	121.9	(1.8)	5,973	(-11.2)	5,545	(-3.5)
	2020	445.1	(-5.7)	1,660.1	(-4.5)	504.5	(5.0)	167.4	(-1.5)	6,602	(-4.8)	6,232	(4.9)
	△77-2020	117.6	(-18.5)	797.3	(-8.9)	204.8	(13.1)	152.8	(-1.5)	1,089	(-21.4)	3,274	(9.7)
	% △	36%		92%		68%		1,047%		20%		111%	

* Wheat, corn, sorghum and soybeans rounded to nearest 0.1 million bushels; alfalfa to nearest one thousand tons; and cotton to nearest one thousand bales.

** Percent change from Baseline Projection for same period.

Table VI-36: MANAGEMENT STRATEGY FIVE-B (MS-5B) - VALUE OF AGRICULTURAL PRODUCTION, BY STATE, SUBREGION AND REGIONAL TOTALS WITH COMPARISON TO BASELINE FOR 2000 TO 2020 (Millions 1977 $)*

State	Year	MS-5B	Change	(%)**
Colorado	1977	275	--	--
	1985	--	--	--
	1990	--	--	--
	2000	395	10	(2.6)
	2020	455	60	(15.2)
	△77-2020	180	60	(50.0)
	%△	65%		
Kansas	1977	655	--	--
	1985	--	--	--
	1990	--	--	--
	2000	1,145	210	(22.5)
	2020	1,560	300	(23.8)
	△77-2020	905	300	(49.6)
	%△	138%		
Nebraska	1977	1,680	--	--
	1985	--	--	--
	1990	--	--	--
	2000	4,665	-100	(-2.1)
	2020	6,360	-95	(-1.5)
	△77-2020	4,680	-95	(-2.0)
	%△	279%		
New Mexico	1977	125	--	--
	1985	--	--	--
	1990	--	--	--
	2000	220	10	(4.8)
	2020	280	60	(27.3)
	△77-2020	155	60	(63.2)
	%△	124%		
Oklahoma	1977	130	--	--
	1985	--	--	--
	1990	--	--	--
	2000	255	10	(4.1)
	2020	330	5	(1.5)
	△77-2020	200	5	(2.6)
	%△	154%		
Texas	1977	1,705	--	--
	1985	--	--	--
	1990	--	--	--
	2000	2,395	-240	(-9.1)
	2020	2,730	-105	(-3.7)
	△77-2020	1,025	-105	(-9.3)
	%△	60%		

Subregions/Region

Subregion	Year	MS-5B	Change	(%)**
North	1977	2,610	--	--
	1985	--	--	--
	1990	--	--	--
	2000	6,205	115	(1.9)
	2020	8,375	265	(3.3)
	△77-2020	5,765	265	(4.8)
	%△	221%		
South	1977	1,960	--	--
	1985	--	--	--
	1990	--	--	--
	2000	2,875	-220	(-7.1)
	2020	3,335	-50	(-1.5)
	△77-2020	1,375	-50	(-3.5)
	%△	70%		
Total Region	1977	4,570	--	--
	1985	--	--	--
	1990	--	--	--
	2000	9,080	-105	(-1.1)
	2020	11,710	215	(1.9)
	△77-2020	7,140	215	(3.1)
	%△	156%		

* All values rounded to nearest $5 million.

** Percent change from Baseline projection for same period.

Table VI-37: MANAGEMENT STRATEGY FIVE-B (MS-5B) - RETURNS TO LAND AND MANAGEMENT BY STATE, SUBREGION AND REGIONAL TOTALS WITH COMPARISON TO BASELINE FOR 2000 TO 2020 (Millions 1977 $)*

State	Year	MS-5B	Change	(%)**
Colorado	1977	90	--	--
	1985	--	--	--
	1990	--	--	--
	2000	130	10	(8.3)
	2020	195	35	(21.9)
	△77-2020	105	35	(50.0)
	% △	117%		
Kansas	1977	210	--	--
	1985	--	--	--
	1990	--	--	--
	2000	680	130	(23.6)
	2020	1,000	145	(17.0)
	△77-2020	790	145	(22.5)
	% △	376%		
Nebraska	1977	555	--	--
	1985	--	--	--
	1990	--	--	--
	2000	1,945	-85	(-4.2)
	2020	2,875	-100	(-3.4)
	△77-2020	2,320	-100	(-4.1)
	% △	418%		
New Mexico	1977	25	--	--
	1985	--	--	--
	1990	--	--	--
	2000	95	5	(5.6)
	2020	145	30	(26.1)
	△77-2020	120	30	(33.3)
	% △	480%		
Oklahoma	1977	30	--	--
	1985	--	--	--
	1990	--	--	--
	2000	60	10	(20.0)
	2020	80	10	(14.3)
	△77-2020	50	10	(25.0)
	% △	167%		
Texas	1977	145	--	--
	1985	--	--	--
	1990	--	--	--
	2000	555	-10	(-1.8)
	2020	790	55	(7.5)
	△77-2020	645	55	(9.3)
	% △	445%		

Subregions/Region

Subregion	Year	MS-5B	Change	(%)**
North	1977	850	--	--
	1985	--	--	--
	1990	--	--	--
	2000	2,755	55	(2.0)
	2020	4,070	80	(2.0)
	△77-2020	3,220	80	(2.5)
	% △	379%		
South	1977	200	--	--
	1985	--	--	--
	1990	--	--	--
	2000	710	10	(1.4)
	2020	1,020	100	(10.9)
	△77-2020	820	100	(13.9)
	% △	410%		
Total Region	1977	1,050	--	--
	1985	--	--	--
	1990	--	--	--
	2000	3,470	65	(1.9)
	2020	5,090	180	(3.7)
	△77-2020	4,040	180	(4.7)
	% △	385%		

Note: Payment of charges for imported water would have to be made from the increase in returns

* All values rounded to nearest $5 million.

** Percent change from Baseline projection for same period.

Table VI-38: MANAGEMENT STRATEGY FIVE-B (MS-5B) REGIONAL ECONOMY - TOTAL VALUE ADDED, ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 Dollars)*

Subregion/ Region	Year	MS-5B	Change	(%)**
North	1977	7,047	-	-
	1985	-	-	-
	1990	-	-	-
	2000	14,793	40	(0.3)
	2020	19,787	151	(0.8)
	△ 77-2020	12,740	151	(1.2)
	% △	181%		
South	1977	14,406	-	-
	1985	-	-	-
	1990	-	-	-
	2000	29,760	-66	(-0.2)
	2020	29,609	69	(0.2)
	△ 77-2020	15,203	69	(0.5)
	% △	106%		
Total Region	1977	21,453	-	-
	1985	-	-	-
	1990	-	-	-
	2000	44,553	-26	(-0.1)
	2020	49,396	220	(0.5)
	△ 77-2020	27,943	220	(0.8)
	% △	130%		

* All values rounded to nearest $1 million.

** Percentage change from Baseline.

Table VI-39: MANAGEMENT STRATEGY FIVE-B (MS-5B) REGIONAL ECONOMY - VALUE ADDED, BY AGRICULTURAL RELATED SECTORS, BY SUBREGION AND REGIONAL TOTALS, WITH COMPARISONS TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 $)*

Subregion/ Region	Year	MS-5B	(%)**	Change	(%)***
North	1977	2,573	(36.5)	-	-
	1985	-	-	-	-
	1990	-	-	-	-
	2000	6,365	(43.0)	55	(0.9)
	2020	9,050	(45.7)	136	(1.5)
	△ 77-2020	6,477	(50.8)	136	(2.1)
	% △	252%			
South	1977	1,669	(11.6)	-	-
	1985	-	-	-	-
	1990	-	-	-	-
	2000	2,991	(10.1)	-51	(-1.7)
	2020	3,969	(13.4)	61	(1.6)
	△ 77-2020	2,300	(15.1)	61	(2.7)
	% △	138%			
Total Region	1977	4,242	(19.8)	-	-
	1985	-	-	-	-
	1990	-	-	-	-
	2000	9,356	(21.0)	4	(0.04)
	2020	13,019	(26.4)	197	(1.5)
	△ 77-2020	8,777	(31.4)	197	(2.3)
	% △	207%			

* All values rounded to nearest $1 million.

** Agriculturally related Value Added or a percentage of Total Value Added.

*** Percentage change from Baseline for MS-5B.

Table VI-40: MANAGEMENT STRATEGY FIVE-B (MS-5B) REGIONAL ECONOMY - TOTAL EMPLOYMENT, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1000's of Full Time Job Equivalents)*

Subregion/ Region	Year	MS-5B	Change	(%)**
North	1977	444.2	-	-
	1985	-	-	-
	1990	-	-	-
	2000	539.9	2.9	(0.5)
	2020	563.2	8.5	(1.5)
	△ 77-2020	119.0	8.5	(7.7)
	% △	27%		
South	1977	563.6	-	-
	1985	-	-	-
	1990	-	-	-
	2000	791.1	-3.5	(-0.4)
	2020	779.7	1.3	(0.2)
	△ 77-2020	216.1	1.3	(0.6)
	% △	38%		
Total Region	1977	1,007.8	-	-
	1985	-	-	-
	1990	-	-	-
	2000	1,331.0	-0.6	(-0.1)
	2020	1,342.9	9.7	(0.7)
	△ 77-2020	335.1	9.7	(3.0)
	% △	33%		

* Rounded to nearest 0.1 thousand jobs.

** Percentage change from Baseline projections for each period.

Table VI-40.1: MANAGEMENT STRATEGY FIVE-B (MS-5B) REGIONAL ECONOMY - TOTAL HOUSEHOLD INCOME FROM ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1,000's of 1977 $)*

Subregion/ Region	Year	MS-5B	Change	(%)**
North	1977	4,909	-	-
	1985	-	-	-
	1990	-	-	-
	2000	9,775	36	(0.4)
	2020	13,531	175	(1.3)
	△ 77-2020	8,622	175	(2.1)
	% △	176%		
South	1977	7,575	-	-
	1985	-	-	-
	1990	-	-	-
	2000	18,754	-61	(-0.3)
	2020	23,619	62	(0.3)
	△ 77-2020	16,044	62	(0.4)
	% △	212%		
Total Region	1977	12,484	-	-
	1985	-	-	-
	1990	-	-	-
	2000	28,529	-25	(-0.1)
	2020	37,150	237	(0.6)
	△ 77-2020	24,666	237	(1.0)
	% △	198%		

* Income rounded to nearest $1 million.

** Percentage change from Baseline projection.

Table VI-41: MANAGEMENT STRATEGY FIVE-B (MS-5B) REGIONAL ECONOMY - POPULATION PROJECTIONS BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1000's of Persons)*

Subregion/ Region	Year	MS-5B	Change	(%)**
North	1977	903	-	-
	1985	-	-	-
	1990	-	-	-
	2000	1,097	6	(0.5)
	2020	1,144	16	(1.4)
	△ 77-2020	241		
	% △	27%		
South	1977	1,268	-	-
	1985	-	-	-
	1990	-	-	-
	2000	1,803	-8	(-0.4)
	2020	1,790	3	(0.2)
	△ 77-2020	522		
	% △	41%		
Total Region	1977	2,171	-	-
	1985	-	-	-
	1990	-	-	-
	2000	2,900	-2	(-0.1)
	2020	2,934	19	(0.7)
	△ 77-2020	763		
	% △	35%		

* Population rounded to nearest thousand persons.

** Percentage change from Baseline projection.

Table VI-42: MANAGEMENT STRATEGY FIVE-B (MS-5B) REGIONAL ECONOMY - AVERAGE PER CAPITA INCOME*, BY SUBREGION AND REGION WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (1977 Dollars)**

Subregion/ Region	Year	MS-5B	Change	(%)***
North	1977	5,436	-	-
	1985	-	-	-
	1990	-	-	-
	2000	8,911	-16	(-0.2)
	2020	11,828	-12	(-0.1)
	△ 77-2020	6,392	-12	(-0.2)
	% △	118%		
South	1977	5,974	-	-
	1985	-	-	-
	1990	-	-	-
	2000	10,402	13	(0.1)
	2020	13,195	13	(0.1)
	△ 77-2020	7,221	13	(0.2)
	% △	121%		
Total Region	1977	5,750	-	-
	1985	-	-	-
	1990	-	-	-
	2000	9,838	-1	-
	2020	12,662	-1	-
	△ 77-2020	6,912	-1	-
	% △	120%		

* Rounded to nearest $1.

** Per Capita Income is Total Household Income divided by Population.

*** Percentage change from Baseline projection.

Table VI-43: MANAGEMENT STRATEGY FIVE-B (MS-5B) REGIONAL ECONOMY - STATE AND LOCAL GOVERNMENT REVENUE GROWTH FROM ALL SECTORS, BY SUBREGION AND REGION, WITH COMPARISON TO BASELINE PROJECTIONS FOR 1977 to 2020 (Millions 1977 $)*

Subregion/ Region	Year	MS-5B	Change	(%)**
North	1977	308.4	-	-
	1985	-	-	-
	1990	-	-	-
	2000	635.8	0.9	(0.1)
	2020	846.6	0.5	(0.1)
	Δ 77-2020	538.2	0.5	(0.1)
	% Δ	175%		
South	1977	564.6	-	-
	1985	-	-	-
	1990	-	-	-
	2000	839.5	-0.5	(-0.1)
	2020	549.5	1.8	(0.3)
	Δ 77-2020	-15.1	1.8	(10.7)
	% Δ	-3%		
Total Region	1977	872.9	-	-
	1985	-	-	-
	1990	-	-	-
	2000	1,475.3	0.4	-
	2020	1,396.1	2.3	(0.2)
	Δ 77-2020	523.2	2.3	(0.4)
	% Δ	60%		

* Values rounded to nearest $0.1 million.
** Percentage change from Baseline projections.

APPENDIX "C"

STATE AND REGIONAL STUDY ELEMENTS

AND

INFORMATION SOURCE AGENCIES OR CONTACTS

APPENDIX "C"

I. STATE AND REGIONAL RESEARCH ELEMENTS

A. State Research - "A" Series

1. The A-1 State Research Tasks: Agricultural and Farm-Level Analysis

a. Task A-1.1: Review crop budgets for different years and different parts of the High Plains; compile data on land classification and land uses.

b. Task A-1.2: Evaluate previously developed agricultural simulation and linear programming models.

c. Task A-1.3: Develop, with the General Contractor, consistent interstate assumptions of cost-price relationships for different crops and livestock.

d. Task A-1.4: Develop, with the General Contractor, consistent interstate assumptions of projected fixed and variable cost components--providing for variation in energy and water costs and constraints.

e. Task A-1.5: Develop, with the General Contractor, consistent interstate assumptions of public policies, yield trends, and variability for crop and livestock production

f. Task A-1.6: Develop reasonably consistent model structures among the states.

g. Task A-1.7: Assemble and verify baseline data on agricultural and irrigation management practices, yields, agricultural output, employment and income, fixed and variable costs, etc.

h. Task A-1.8: Test and refine models.

i. Task A-1.9: Simulate agricultural production under the varying assumptions developed in Tasks A-1.3, 4, and 5 and the alternative development strategies formulated by the General Contractor with the concurrence of the High Plains Study Council.

j. Task A-1.10: Project agricultural output, values, costs, farm employment, income, and water demand for the High Plains area of each state under alternative development strategies; project irrigation water demands and payment capacity for supplemental water for those strategies involving augmentation of supply.

k. Task A-1.11: Project agribusiness employment and income for the High Plains portion of each state under the varying assumptions and strategies.

l. Task A-1.12: Project agricultural output, employment, and income, etc., for the non-Ogallala portion of each state.

2. The <u>A-2</u> State Research Tasks: Energy Production Impacts

a. Task A-2.1: Identify and review state energy data sources.

b. Task A-2.2: Review energy data specifications.

c. Task A-2.3: Determine method of satisfying the specification with the General Contractor.

d. Task A-2.4: Identify/develop method of projecting energy data time profiles.

e. Task A-2.5: Project energy data profiles as required by the specification.

f. Task A-2.6: Compile data, prepare report, and forward to the General Contractor.

3. The <u>A-3a</u> State Research Tasks: Regional Water Resources and Demands

a. Task A-3.1: In cooperation with the USGS and the General Contractor, compile available data and describe the geologic structure, hydrology, and the ground water and aquifer characteristics of the Ogallala and peripheral aquifers, including information on precipitation, streamflow, recharge, natural discharge, movement of ground water, quality, interrelationships among aquifers, etc.

b. Task A-3.2: In cooperation with the USGS and General Contractor, and with inputs from Elements A-1 and A-2, divide the High Plains area within the state into subregions, consistent with subregions of adjoining states, which can be analyzed more or less discreetly, based on geologic, hydrologic, and economic considerations.

c. Task A-3.3: In cooperation with the USGS, compile available data, and describe and quantify to the extent possible, the ground water resources now remaining in the Ogallala Aquifer within the state, including quality problems resulting from point, nonpoint, and natural sources, for each subregion.

d. Task A-3.4: Compile available data and describe and quantify, to the extent possible, existing and potential intrastate sources of water supply--surface, ground reclaimed--other than the Ogallala Aquifer for use within the High Plains by subregions; describe any existing legal, regulatory, or other institutional constraints on development and use of such other sources.

e. Task A-3.5: Compile available data and describe and evaluate any current or planned activities and developments--regulatory or physical--at the federal, state and local levels of government and by private entities to augment the water supply to the High Plains or to extend the useful life of the remaining water resources in the Ogallala Aquifer, and their estimated costs; describe and evaluate actions being taken or planned to maintain or improve the quality of water in the Ogallala Aquifer and the estimated costs.

f. Task A-3.6: In cooperation with the USGS, compile available data on historic water use for various purposes in the High Plains area within the state by subregions.

APPENDIX "C" (Cont'd)

g. Task A-3.7: In cooperation with the General Contractor work in B-8, as to future costs of energy and effects of inflation on costs, develop and verify costs of pumping from the Ogallala Aquifer by subregion over the planning period.

h. Task A-3.8: In cooperation with the General Contractor, project water demands over the planning period for the various purposes and available supplies for each of the alternative development strategies by subregion.

i. Task A-3.9: In cooperation with USGS, project the response of the Ogallala Aquifer overtime by subregion for each of the alternative development strategies; this must be consistent with similar studies in adjoining states where the Ogallala Aquifer extends across state lines; existing ground water simulation models, refined as necessary, will be used where available; new models will be developed as necessary and feasible within the limits of available data and time.

4. The A-3b State Research Tasks: Economic Impacts

a. Task A-3.10: Review economic base profiles for different years for the High Plains area within the state by subregion, and for other areas in the state.

b. Task A-3.11: Evaluate previously developed input-output (I-O) models for the state or for regions within the state.

c. Task A-3.12: In cooperation with the General Contractor, revise existing I-O models as necessary or develop new intrastate or multistate I-O models with reasonably compatible structures and consistent inter-industry coefficients.

d. Task A-3.13: Conduct additional research and interviews to disaggregate key crop, livestock, and energy functions in the state-level models to subregional delineation.

e. Task A-3.14: Review economic/demographic basic data and projections, and project time profiles of inter-industry coefficients and any independent changes in basic economic activities.

f. Task A-3.15: Test I-O models over a relevant period.

g. Task A-3.16: Use I-O and relevant models to project time profiles of alternative economic structures and the economic impacts--irrigated acreage, production, employment, income, etc.--for each alternative development strategy for the Ogallala Aquifer area of the state by subregion, and for regions of the state outside the area.

Task A-3.17: Describe and evaluate the socioeconomic impacts of each alternative development strategy within the Ogallala Aquifer area and outside that area in the state.

B. Regional Research - "B" Series

1. Regional Element B-1: Interbasin Transfer Assessment

a. Task B-1.1: Review past studies and current Corps study.

b. Task B-1.2: Formulate alternatives.

c. Task B-1.3: Screen alternatives.

d. Task B-1.4: Perform detailed studies.

e. Task B-1.5: Prepare task report.

2. Regional Element B-2: National and Regional Impact Assessment

a. Task B-2.1: Develop a consolidated regional data base.

b. Task B-2.2: Estimate the potential for interregional shifts in U.S. agricultural production.

c. Task B-2.3: Estimate the change in prices for agricultural commodities and actual interregional shifts in agricultural production.

d. Task B-2.4: Develop a methodology for predicting shifts in consumer expenditures for food and fiber products.

e. Task B-2.5: Project changes in U.S. consumer prices and the shift in consumer expenditures for food and fiber products.

f. Task B-2.6: Project the impact of food and fiber prices on the U.S. inflation rate and the U.S. balance of payments.

APPENDIX "C" (Cont'd)

3. Regional Element B-3: Agricultural and Water Technology Assessment

   a. Task B-3.1: Identify technological and management advances.

   b. Task B-3.2: Evaluate impacts of advancements in technology.

   c. Task B-3.3: Assess future research needs and priorities.

   d. Task B-3.4: Identify and assess means to accelerate adoption of advanced technology.

4. Regional Element B-4: Environmental Impact Assessments

   a. Task B-4.1: Develop present environmental baseline description.

   b. Task B-4.2: Evaluate potential of unconventional techniques.

   c. Task B-4.3: Develop economic, operational, institutional, and environmental profiles.

5. Regional Element B-5: Unconventional Water Supply Assessment

   a. Task B-5.1: Assess the state-of-the-art.

   b. Task B-5.2: Evaluate potential of unconventional techniques.

   c. Task B-5.3: Develop economic, operational, institutional, and environmental profiles.

6. Regional Element B-6: Institutional Assessment

   a. Task B-6.1: Review existing laws, institutions, and programs.

   b. Task B-6.2: Evaluate legal and institutional impacts and requirements.

7. Regional Element B-7: Crop Prices Assessment

   a. Task B-7.1: Estimating output prices.

   b. Task B-7.2: Projecting agricultural productivity.

   c. Task B-7.3: Estimate input prices.

   d. Task B-7.4: Projecting input mix.

   e. Task B-7.5: Synthesis and check of estimation parameters

APPENDIX "C" (Cont'd)

8. Regional Element B-8: Energy Price and Technology Assessment

   a. Task B-8.1: Review available information and develop preliminary energy price projection.

   b. Task B-8.2: Prepare specifications for data development by the states.

   c. Task B-8.3: Review energy data prepared by the states.

   d. Task B-8.4: Develop regional energy data.

   e. Task B-8.5: Survey energy price models.

   f. Task B-8.6: Select/develop energy price model.

   g. Task B-8.7: Survey regulatory environment in the Region.

   h. Task B-8.8: Generate interim energy price information.

   i. Task B-8.9: Assess the impacts of new energy supply technologies.

   j. Task B-8.10: Determine the existence and influence of long-term energy supply contracts.

   k. Task B-8.11: Assess water quality and quantity requirements for energy supply.

   l. Task B-8.12: Adjust energy forecast.

   m. Task B-8.13: Assess impacts of energy shortfalls..

   n. Task B-8.14: Final energy report.

9. Regional Element B-9: Dryland Farming Assessment

   a. Task B-9.1: Selection of development measurement indicators.

   b. Task B-9.2: Selection of sample areas for comparative analysis.

   c. Task B-9.3: Data collection.

   d. Task B-9.4: Comparative analysis of irrigated vs. non-irrigated areas.

   e. Task B-9.5: Analysis of areas with a declining irrigated agriculture.

APPENDIX "C" (Cont'd)

f. Task B-9.6: Evaluation of preliminary baseline projections of Elements A-1 and A-3.

g. Task B-9.7: Estimation of consequences of transition to dryland farming.

10. Regional Element B-10: Nonagricultural Development Potential Assessment

a. Task B-10.1: Inventory potential impacts of water, energy, and agricultural resources.

b. Task B-10.2: Inventory potential impacts of other resource potentials.

c. Task B-10.3: Inventory potential impacts of public policies.

d. Task B-10.4: Evaluate recent trends in nonagricultural development.

e. Task B-10.5: Evaluate existing projections of nonagricultural activities.

f. Task B-10.6: Screen nonagricultural development potential by industry.

g. Task B-10.7: Analyze development potential of selected industries.

h. Task B-10.8: Project regional level of nonagricultural activities under alternative assumptions.

i. Task B-10.9: Project amount of offsetting nonagricultural development needed.

j. Task B-10.10: Evaluate potential for increased nonagricultural activity.

11. Regional Element B-11: Assessments of Alternative Regional Development Strategies

a. Task B-11.1: Initial definition and subsequent refinement of alternative development strategies.

b. Task B-11.2: Coordination of strategy analyses.

c. Task B-11.3: Evaluation of alternatives. This assessment is presented herein. To make the comparisons a regional I/O was developed and this model is described in Study Element B-11.

II. Information Source Agencies or Contacts

A. State Study Elements "A" Series

1. Colorado Department of Agriculture
1525 Sherman Street
Denver, Colorado 80203
Phone: 303/866-3219

2. Kansas Water Office
503 Kansas Avenue, Suite 303
Topeka, Kansas 66603
Phone: 913/296-3185

3. Nebraska Natural Resources Commission
301 Centennial Mall South
P. O. Box 94876
Lincoln, Nebraska 68509
Phone: 402/471-2081

4. New Mexico Interstate Stream Commission
State Engineer - Bataan Memorial Building
State Capitol
Santa Fe, New Mexico 87503
Phone: 505/827-2127

5. Oklahoma Water Resources Board
Northeast 10th and Stonewall
Oklahoma City, Oklahoma 73152
Phone: 405/271-2557

6. Texas Department of Water Resources
P. O. Box 13087, Capitol Station
Stephen F. Austin State Office Building
Austin, Texas 78711
Phone: 512/475-3821

B. Regional Study Elements - "B" Series

1. Camp Dresser & McKee Inc.
3445 Executive Center Drive, Suite 220
Austin, Texas 78731
Phone: 512/345-9820
(Study Elements B-1, B-3, B-4, B-5 and B-6)

2. Black & Veatch
P. O. Box 8405
Kansas City, Missouri 64114
Phone: 913/967-7199
(Study Element B-8)

3. Arthur D. Little, Inc.
   25 Acorn Park
   Cambridge, Massachusetts 02140
   Phone: 617/864-5770, Ext. 5494
   (Study Elements B-2, B-7, B-9, B-10 & B-11)

C. Federal Agency Participants

1. U.S. Department of Commerce
   Economic Development Administration
   Office of Economic Research - Main Commerce Building
   Washington, D.C. 20230
   Phone: 202/387-4085

2. U.S. Army Corps of Engineers
   Southwestern Division
   1114 Commerce Street
   Dallas, Texas 75242
   Phone: 214/767-2312

3. U.S. Geological Survey
   Water Resources Division
   P. O. Box 25046, Mail Stop 412
   Denver Federal Center
   Lakewood, Colorado 80225
   Phone: 303/234-6017

4. U.S. Fish and Wildlife Service
   P. O. Box 1306
   Albuquerque, New Mexico 87103
   Phone: 505/766-2914

APPENDIX "D"

SIX-STATE HIGH PLAINS-
OGALLALA AQUIFER
REGIONAL RESOURCES STUDY

REVIEW AND COMMENT PROCESS

APPENDIX "D"

REVIEW AND COMMENT PROCESS

There has been a multiphase review and comment process in action throughout the Six-State High Plains-Ogallala Aquifer Regional Resources Study.

The first phase has been an ongoing public participation and information effort involving well advertised open public meetings of the High Plains Study Council, the Council's State Liaison Committee meetings and other similar meetings scheduled frequently--several times each year--throughout the six study states. Concurrently the High Plains Study Council has issued a periodic newsletter called the HPSC Bulletin to provide current information on High Plains Study activities, study progress, and other public information relevant to the Study. The bulletin is mailed to more than 1,300 interested individuals or organizations throughout the country.

Throughout the life of the project, members of the General Contracting team have met with organizations and groups throughout the Study region and in other parts of the country to make presentations on the Study and its results.

A second phase of public review and comment on the High Plains Study has been a series of annual Congressional briefings scheduled by the Study Council in Washington, D.C. The purpose of these briefings has been mainly to keep Congressional leaders informed on the Study and its progress, but other attendees have been representatives of interested federal agencies and national organizations. A final Congressional briefing is to be scheduled when the High Plains Study Council issues its report to the Secretary of Commerce and the Congress.

A series of seven public Scoping Hearings, one in each of the six study states and one in Washington, D.C. were held by the U.S. Department of Commerce, Economic Development Administration (EDA) during the period April through August of 1981. These Scoping Hearings were for the purpose of soliciting public comment for an environmental assessment of the Study region. EDA was assisted in these hearings by the General Contractor and a record of the comments received is available from project records. All comments were considered in the process of preparing a survey level environmental assessment for the Study region.

Another phase of the public review and comment process is centered around intrastate review committees organized by several of the study states to hold public meetings in the respective states throughout the course of the Study. Many of the concerns and comments expressed at these individual state meetings are reflected in the results of the separate state studies (and through the State Liaison Committee, into the Study Draft Final Report).

Two review committees have functioned to provide guidance and assistance to the Study on technical and methodological/analytical aspects of the Study. The General Contractor organized a Technical Consulting Panel made up of nationally prominant authorities in the areas of economics, engineering, hydrology, water law and institutions, energy, agriculture and other specializations. This Panel has provided ongoing review and comment on technical and analytic methods and results for the Study.

The responsible federal agency for administering the High Plains Study, the EDA, has organized a federal level review committee called the Technical Assistance Group, or TAG. Comments from the TAG have been provided through the EDA as appropriate.

A preliminary Draft Final Report for the Six-State High Plains-Ogallala Aquifer Regional Resources Study, issued by the General Contractor in early January 1982, has undergone intensive review and comment in preparation for the revised High Plains Study Draft Final Report.

Comments have been submitted from six study states, from participating and interested federal agencies, from the General Contractor's Technical Consulting Panel, from EDA, and from others. All comments (several hundred) have been recorded in project files and have been considered in the preparation of the Study's Draft Final Report. Where feasible, nonconflicting comments or suggested changes that offer constructive improvements in the Draft Report have been incorporated.

A final phase of the public review and comment process for the High Plains Study will be a series of public meetings throughout each of the six study states to present the Study results and the preliminary findings and recommended actions of the High Plains Study Council. This process will ultimately be reflected in the Council's report to the Secretary of Commerce and to Congress in late 1982.

SIX-STATE
HIGH PLAINS
OGALLALA
AQUIFER REGIONAL
RESOURCES STUDY