IV SUMMARY AND RECOMMENDATIONS

A. RESULTS OF THE RIVER OPERATION STUDIES

Several model runs were executed and analyzed utilizing the HYDROSS simulation model. These runs consisted of existing conditions, future condition baseline scenarios, simulation of various features under consideration for enhancing existing water supplies, and simulation of potential Alternatives (Feature combinations) to meet demands in the Red River Valley. An overview of each feature model run is found in Table 153 and each Alternative in Table 154 showing the largest annual shortages and reservoir start, maximum, minimum, and average capacity. The ring-dikes that were utilized for Alternatives 2 through 6 are included in Table 154.

In general, the value of each feature and alternative was driven by the critical drought of the 1930's. If a similar drought occurred in the future, shortages and streamflow conditions that were computed by the model could potentially occur. Therefore, the value of each feature and alternative was generally described in this document in terms of its effectiveness in supplying water during this drought. In most cases, the worst case year of simulation was 1934. This year was critical to the hydrologic analysis as it generally related to the firm yield of each feature.

The Technical Steering Committee set criteria for narrowing the focus of selecting best-suited features for this study. The main criterion is that to be valid, a feature or group of features must meet all M&I demands in the Red River Valley. Only one feature met this criterion – import from the Missouri River Basin from various points. This represents the out-of-basin (import) Alternatives 5 through 8 for meeting all M&I demands in the Red River Valley.

In addition to the out-of-basin alternatives, in-basin water supply configuration was also sought to meet all M&I demands. Alternatives 2 through 4 that combined several features were observed to meet this criteria

A ranking of Features and how they faired in meeting city, industry, and total M&I needs for the entire 54-year simulation is listed in Table 155 and Figures 31 through 34. This table and associated Figures indicate that only four model runs (full import – optimized and not optimized, and in-basin demands with adequate pre-drought moisture conditions) were able to meet the criteria of satisfying all city and industrial demands in the Red River Valley (minor miscellaneous industry not included).

Regarding the 1930's drought which peaked from mid-1933 to mid-1940, similar results were obtained. This drought period actually was the driver of how well a Feature would meet in-basin water needs. Table 156 and Figures 35 through 38 list and illustrate how each Feature ranked in meeting M&I demands through the critical drought. Again only four model runs (full import – optimized and not optimized, and in-basin demands with adequate pre-drought moisture conditions) were able to meet the criteria of satisfying all city and industrial demands in the Red River Valley (minor miscellaneous industry not included). Most single Features therefore could be eliminated as prospects in meeting the Steering Committee requirement as a future water supply. However, when several features are combined, both in- and out-of –basin alternative solutions could be devised. Several more model runs could be made for testing other combinations and ways of optimizing water supplies to meet demands in the year 2050.

The following Tables summarizes the model simulation for each Alternative for the period of study 1931-1984:

- Table 154 shows the largest annual shortages and reservoir start, maximum, minimum, and average capacity. The ring-dikes that were utilized for Alternatives 2 through 6 are included.
- Table 157 shows months above channel capacity. All the stations are the same as Alternative 1 except for Sheyenne River at Warwick that shows Alternative 7 having one more month above channel capacity.
- Table 158 shows Lake Ashtabula operation data for maximum, minimum, and average elevation, surface area, and capacity for each Alternative.
- Table 159. shows average, highest and lowest monthly flow and annual median flow for each Alternative. Flows are similar to Alternative 1 above Lake Ashtabula except for Alternative 7, which are about 70 cfs higher. Below Lake Ashtabula to Lisbon the flows are similar to Alternative 1 except for Alternative 4 and 7, which range from 12 cfs to 70 cfs higher. Below Kindred to Emerson all the Alternatives are higher than Alternative 1 except for Alternatives 2 and 3 which are lower. The Fargo station Alternative 7 is the same as Alternative 1 ; Alternatives 2 and 4 are lower; Alternatives 5, 6, and 8 are higher.

The following attachments summarizes the study period and drought period:

- Attachment L shows the Lake Ashtabula, Lake Kindred, and ring-dike end of month contents for the 1931 through 1941 drought period.
- Attachment M compares average monthly flow at each station for each Alternative for the period of study 1931 through 1984 and the 1931 through 1940 drought period. Figures compare average monthly flow for the 1931 through 1940 drought period.
- Attachment N compares median monthly flow at each station for each Alternative for the period of study 1931 through 1984 and the 1931 through 1940 drought period. Figures compare average monthly flow for the 1931 through 1940 drought period.
- Attachment O compares Baseline 1994 condition to Alternative 1 2050 condition median and mean monthly flow at each station and EOM content for Lake Ashtabula for each Alternative.

The features did not include surface water supply to rural water needs. It was assumed that this supply would be from groundwater. It should be noted that rural areas, including smaller towns and cities that are using ground water, are expected to be able to continue that use. Aquifer declines would be expected in a drought situation; however, the aquifers are assumed to be capable of continued support to current users. This assumption is based upon the projected declining or stable population trends in the rural sector and no expansion of ground water used for irrigation. If aquifer depletions begin to be apparent, then the State water appropriation priority dates would take effect to allocate which users could continue and which would be limited. Suburban growth, however, could impose some increases in ground water demands. Some suburban development has had to be served by expansion of rural water district facilities, which in turn expand the use of their ground water supplies. The feature studies do not include impacts of expanded ground water uses. Projected population declines in the rural community would mean that the existing water uses could be maintained.

The Alternatives met all the M&I water needs and included surface water supply to rural water needs except the expanded Ashtabula Alternative 3. Alternative 3 included groundwater supply to rural water needs to meet shortages.

B. RECOMMENDATIONS

This appraisal-level water needs assessment has provided information on the potential unmet water demands of several major cities in the Red River Valley along with potential limitations on the availability of additional ground water form municipalities and rural water systems. Actual water demand may fall somewhere between the Bureau of Reclamation's projections and Participant projections. Features have been evaluated based on Reclamation demand estimates and should be viewed in terms of a trend analysis approach. Several recommendations are suggested if this study were to continue in a more detailed manner.

a. The Minnesota side of the Red River Valley should be analyzed for the model in as much detail as the North Dakota side. This would include detailed operations of Lake Traverse, Orwell, and the Red Lakes. This would move the water needs assessment in the direction of a basin-wide analysis.

b. Additional future demands for unknown development (New Industry plants) should be further researched. The New Industry demand centers used in this report are based more on speculation than hard science. A cross section of potential industrial development is suggested to better define these potential demands.

c. More detail regarding irrigation should be considered.

Table 153 - Red River Phase II Model Feature Scenario Simulation Summary

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Model Simulation	Model Run	Demand Cond.	Largest Annual Shortage for year 1934 (AF)			Lake Ashtabula Storage Capacity (AF)				Lake Kindred Storage Capacity (AF)			
			City	Other[1]	Total	Start	Max.	Min.	Avg.	Start	Max.	Min.	Avg.
Existing/Baseline	R30K94	1994	2,290	190	2,480	28,000	68,160	30,101	63,634	N/A	N/A	N/A	N/A
Future Condition	R30K50	2050 USBR	31,400	22,160	53,560	28,000	66,600	28,000	59,138	N/A	N/A	N/A	N/A
Future Condition	P30K50	2050 City	57,220	23,690	80,910	28,000	66,600	28,000	58,520	N/A	N/A	N/A	N/A
Feature #1 Enlarge Ashtabula a. Min. Enlargement b. Max. Enlargement	R19E50 R19F50	2050 USBR	28,300 5,360	22,160 16,680	50,460 22,040	1,200 28,000	72,600 190,000	1,200 15,550	60,854 168,516	N/A	N/A	N/A	N/A
Feature #2 Build New Kindred Res. a. Start at Conservation Capacity b. Start at Dead Pool Capacity	RKIN50F RKIN50E	2050 USBR	5,360 5,360	16,680 22,160	22,040 27,520	28,000 1,200	66,600 66,600	28,000 28,000	61,480 61,305	180,000 0.0	180,000 50,000	49,670 90	164,660 2,198

1. Other is New Industrial shortages including ag-processing type industry. This does not include irrigation of about 14,100 AF.

Model Simulation	Model Run	Demand Cond.	Largest Annual Shortage for year 1934 (AF)			Lake Ashtabula Storage Capacity (AF)				Maple River Reservoir Storage Capacity (AF)			
			City	Other	Total	Start	Max.	Min.	Avg.	Start	Max.	Min.	Avg.
Feature #3 Build New Maple River Res. a. Start at Conservation Capacity b. Start at Dead Pool Capacity	RMAP50F RMAP50E	2050 USBR	22,450 22,153	9,724 21,080	32,174 43,233	28,000 1,200	66,600 66,600	28,000 28,000	59,210 59,208	44,000 1000	40,420 22,000	1,000 1,000	34,084 18,505
Feature #4 Supply Water to the Upper Red River from Maple River Res.	Based on Feature #3	2050 USBR	Speculated that only about 16,000 AF of the upper Red shortage could be met										
Feature #5 Offstream Storage near Fargo to Supply Water to the Upper Red	Based on Feature #3	2050 USBR	Speculated that only about 16,000 to 22,000 AF of the upper Red could be met										
Feature #6 Purchase mainstream Red and Sheyenne River surface water irrigation rights for M&I	RIRR50C	2050 USBR	30,710	19,540	50,250	28,000	66,600	28,000	59,329				
Feature #7 Secure additional unappropriated ground water and pump from the Spiritwood Aquifer		2050 USBR	Not modeled with HYDROSS. Refer to Feature #7 discussion of results.										

Feature #8 Acquire existing ground water rights by purchasing landfrom irrigators who are willing sellers		2050 USBR	Not modeled with HYDROSS. Refer to Feature #8 discussion of results..
Feature #9 Aquifer water storage and recovery a. Utilize West Fargo north aquifer b. Utilize Elk Valley Aquifer		2050 USBR	Not modeled with HYDROSS. Refer to Feature #9 discussion of results.
Feature #10 Build desalinization plant to treat water from Dakota Aquifer		2050 USBR	Not modeled with HYDROSS. Refer to Feature #10 discussion of results.

Model Simulation	Model Run	Demand Condition	Largest Annual Shortage For year 1934 (AF)			Lake Ashtabula Storage Capacity (AF)			
			City	Other	Total	Start	Max.	Min.	Avg.
Feature #11 Augmentation of M&I supply in the Red from utilizing wastewater reuse for cities of Fargo, Grand Forks and Wahpeton Cargill plant	RRUC50C	2050 USBR	32,630	22,080	54,710	28,000	66,600	28,000	59,163
Feature #12 Added conservation programs for participating cities	RCON50	2050 USBR	21,340	18,700	40,040	28,000	66,600	28,000	59,642
Feature #13 Drought Contingencies - Use Lake Ashtabula storage normally used for fish, wildlife, & recreation	ROOK50	2050 USBR	27,860	22,160	50,020	28,000	66,600	1,200	56,739
Feature #14 Import water to the upper Sheyenne River from Missouri River or Devils Lake Basin	RIMPS50	2050 USBR	2,520	16,680	19,200	28,000	66,600	28,000	61,346
Feature #15 Import water to the upper Red River via the Wild Rice River	RIMPR50	2050 USBR	1,870	4,190	8,060	28,000	66,600	28,000	59,193
Feature #16 Import water to the Red River via a. pipe from Bismarck to Wahpeton b. pipe from Lisbon to Wahpeton	Based on Feature #15	2050 USBR	Refer to Feature #16a and 16b discussions.						
Feature #17 Rural water systems	RURAL50	2050 USBR	Refer to Feature #17 discussion.						

Note: Feature #14 the 1933 shortage for city is 5,360 AF and other is 14,990 AF for a total of 20,350 AF.

Model Simulation	Model Run	Demand Condition	Largest Annual Shortage for year 1934 (AF)			Lake Ashtabula Storage Capacity (AF)			
			City	Other	Total	Start	Max.	Min.	Avg.
Feature #18 Bismarck to Fargo pipeline to Import Missouri River water to Fargo-Moorhead	RIMRF50	2050 USBR	330	11430	11760	28,000	66,600	28,000	59,641
Feature #19 McClusky Canal to Hillsboro pipeline to import Missouri River water to meet all M&I needs	RIMRS50	2050 USBR	0.0	710	710	28,000	66,600	28,000	61,397
Feature #20 Jamestown to Fargo pipeline to Import Missouri River water to Fargo-Moorhead	RIMRF50	2050 USBR	330	11430	11760	28000	66000	28000	59641
Feature #21 Rural water system supplied by Western Valley Red River Pipeline	Based on Baseline	2050 USBR	Evaluation for Pipeline sizes based on run R30k50 Shortages (Reclamation baseline run).						

Table 154: Red River Phase II Model Action Alternative Simulation Summary

Model Simulation	Model Run	Largest Annual Shortage (AF)				Lake Ashtabula Storage Capacity (AF)				Lake Kindred Storage Capacity (AF)				Red River near Fargo Ring-dike (AF)				Sheyenne River near Fargo Ring-dike (AF)			
Action Alternative		City	Other	Total	Year	Start	Max.	Min.	Avg.	Start	Max.	Min.	Avg.	Start	Max.	Min.	Avg.	Start	Max.	Min.	Avg.
Reclamation 2050 Projections																					
Baseline (1994)	Baseline	31030	22160	53190	1934	47300	66600	26300	59530												
Alternative 1	Alt1	31030	22160	53190	1934	47300	66600	26300	59530												
Alternative 1	Alt1R	31470	22160	53630	1934	47300	66600	26300	59480												
Alternative 2	Alt2R	0.0	0.0	0.0		47300	66600	27460	61520	42000	84000	0.0	72190	11000	22000	0.0	19260				
Alternative 3	Alt3-28B	0.0	0.0	0.0		75300	122600	27590	107850					11000	22000	0.0	19270	22000	22000	1590	21810
Alternative 4	Alt41LAR	6990	600	7590	1934	47300	66600	27220	59400					11000	23000	0.0	19190	23000	23000	1000	22430
Alternative 5	Alt5A1R &Alt5B	0.0	0.0	0.0		47300	66600	30490	62220					12000 12000	12000 12000	1000 5480	11300 11930				
Alternative 6	Alt6R	0.0	0.0	0.0		47300	66600	30790	62260					23000	23000	1860	21930				
Alternative 7ABC	Alt7ABCR	0.0	0.0	0.0		66600	66600	28260	64550												
Alternative 7D	Alt7DR	0.0	0.0	0.0		66600	66600	28260	64550												
Alternative 8	Alt8R	0.0	0.0	0.0		66600	66600	26850	60420												
Participant 2050 Projections																					
Alternative 1	Alt1P	57220	23690	80910	1934	47300	66600	26300	59530												
Alternative 2	Alt2RP	58740	19110	77850	1934	47300	66600	26620	60000	15000	30000	0.0	26850	11000	22000	0.0	17840				
Alternative 3	Alt3P	62200	13860	76060	1934	37700	75400	4120	64080					11000	22000	0.0	18000				
Alternative 5	Alt5A1RP	0.0	0.0	0.0		47300	66600	30490	62220					12000	12000	1000	11300				
Alternative 7ABC	Alt7ABCRP	0.0	0.0	0.0		66600	66600	28260	64550												

Note: "R" is designated with Rural demands
"P" is designated with Participant 2050 demand projections
Alternative 1 is No Action
Alternative 4 shortages would be supplied from Dakota Aquifer use through desalination plants.
Alternative 5A1R simulated two half sized (11,000 AF) ring-dikes slaved to the import and upper Red River spur pipeline.
Alternative 5BR simulated one 23,000 AF ring-dikes near Fargo.

Table 155: Total Shortages for 54 Year Model Period for each Feature

Total Shortages for 54 Year Model Period	Shortages in KAF		
	Total City	Total Industry	Total M&I
Import to Red & Sheyenne: ZRIMRS50	0	5.53	5.53
Optimized Red&Shey. Import w/Cons Demand XFIRMIM	0	5.53	5.53
Cons. w/Kindred Lake, HALF FULL Start: XCKMH0R	0	5.57	5.57
Cons. w/Kindred Lake, FULL Start: ZRCKMF0R	0	5.68	5.68
1994 Baseline RunZR30K94	10.08	16.24	26.32
Import to Upper Red R. Only RIMPR50	5.67	40.08	45.75
Kindred & Maple Res.Empty Start\Cons: ZRCKME0R	14.28	48.94	63.22
Optimized Fargo Pipeline Import w/Surf Storage RIFMRNG	0.39	101.68	102.07
Pipeline Import to Fargo w/new ind2. and Cons: ZRCNIMRF	20.21	100.86	121.07
Pipeline Import to Fargo w/new ind2: ZRIMRF50	6.14	127.51	133.65
Cons & Kindred Lake ZRCNKINE	17.88	122.87	140.75
Enlarged Ashtabula w/Cons&Full Start ZRCN19F0	17.88	123.05	140.93
Cons.w/Kindred and Maple Res.Empty Start: ZRCNKME	17.67	123.79	141.46
Sheyenne R. Import: ZRIMPS50	25.16	156.62	181.78
Kindred Lake (Full Start): ZRKIN50F	25.54	156.44	181.98
Enlarged Ashtabula; Full Start ZR19F50	25.16	156.94	182.10
Ring Dike (22,000 ac-ft) with high Spring Flows on Red River only	56.51	141.14	197.65
Maple Res.w/Cons;Empty Start ZRCNMAPE	53.57	167.06	220.63
Enlarged Ashtabula w/Cons&Empty Start ZRCN19E0	61.39	170.97	232.36
Cons & No Min Pool in Ashtabula ZRCON00	71.65	171.53	243.18
Kindred Lake (Empty Start) ZRKIN50E	30.03	214.48	244.51
2050 Baseline Conservation Scenario ZRCON50	96.10	169.46	265.56
Maple Reservoir Full Start ZRMAP50F	76.34	209.24	285.58
Maple Reservoir Empty Start ZRMAP50E	94.26	209.30	303.56
Yr 2050 Recl. Demand/No Min. Pool: ZR00K50	111.33	214.00	325.33
Enlarged Ashtabula Empty Start ZR19E50	111.44	214.00	325.44
Irrigation Buyout Red&Sheyenne R: ZRIRR50C	139.37	195.78	335.15
Wastewater Reuse ZRRUC50A	144.45	213.12	357.57
2050 Recl. Demand w/min pool ZR30K50	147.43	214.00	361.43
2050 Participant ZP30K50	360.49	281.70	642.19

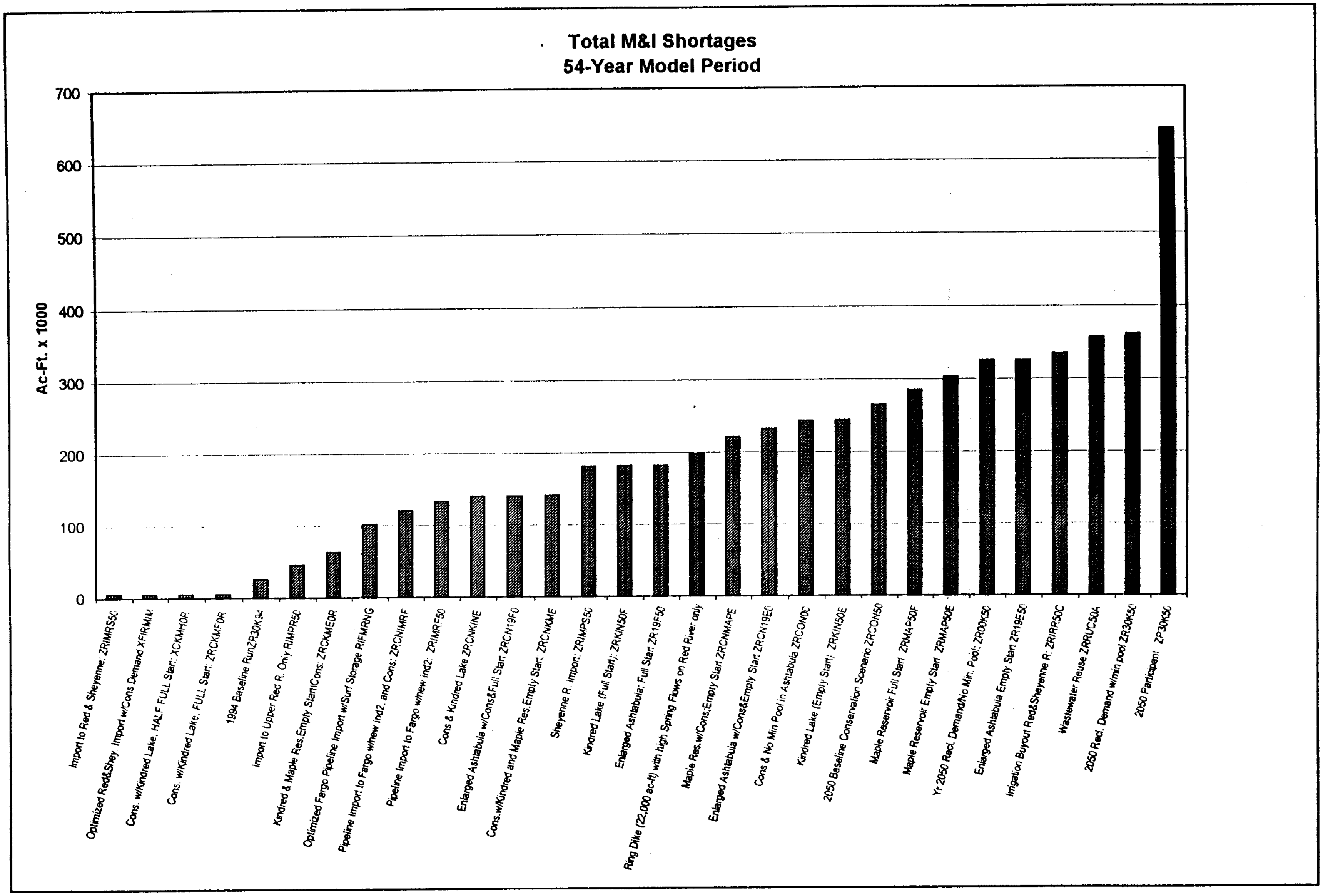

Figure 31: Total Municipal and Industrial *Shortages - 54 Year Period (by Feature Ranking)*

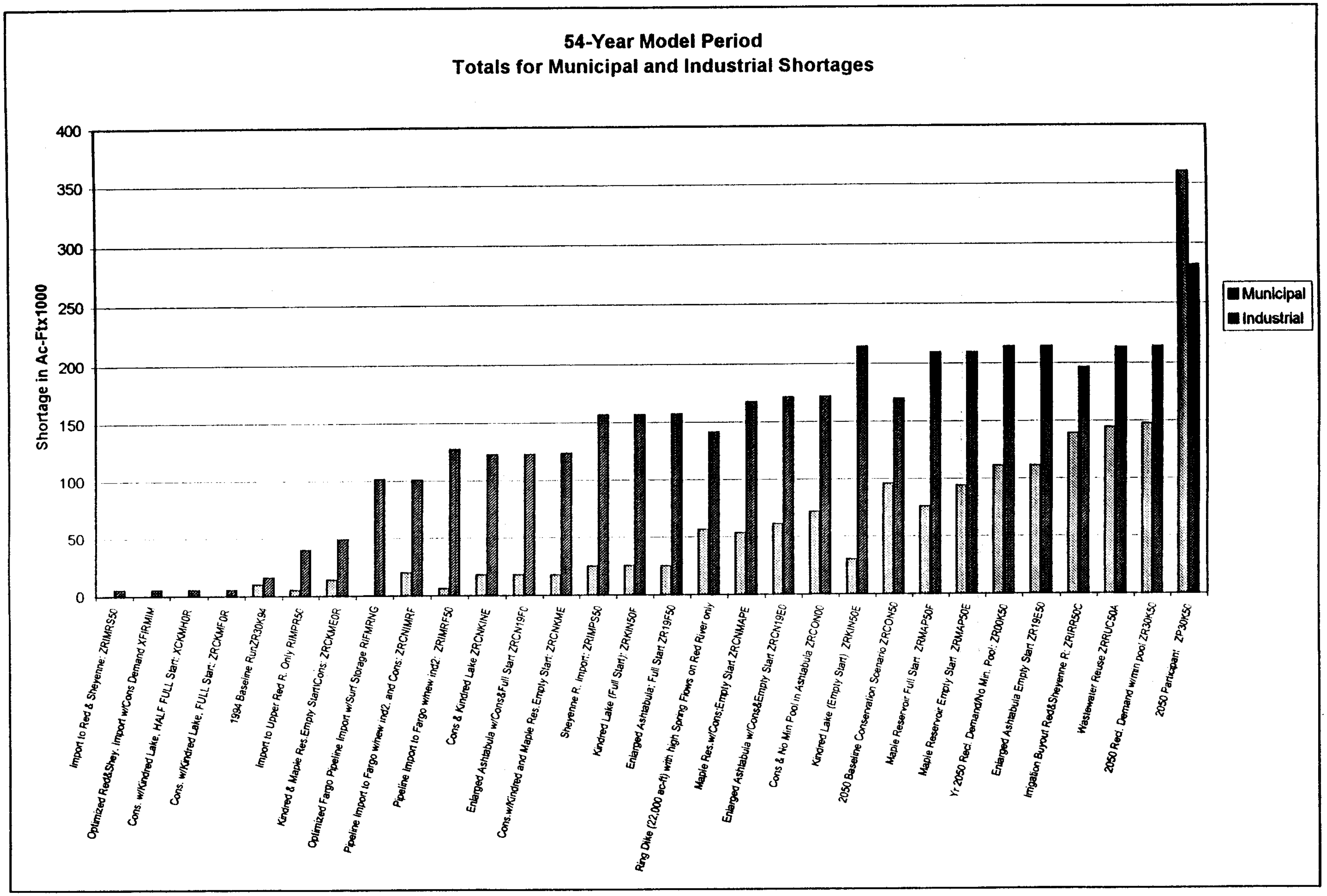

Figure 32: Totals for Municipal and Industrial Shortages - 54 Year Period (by Feature Ranking)

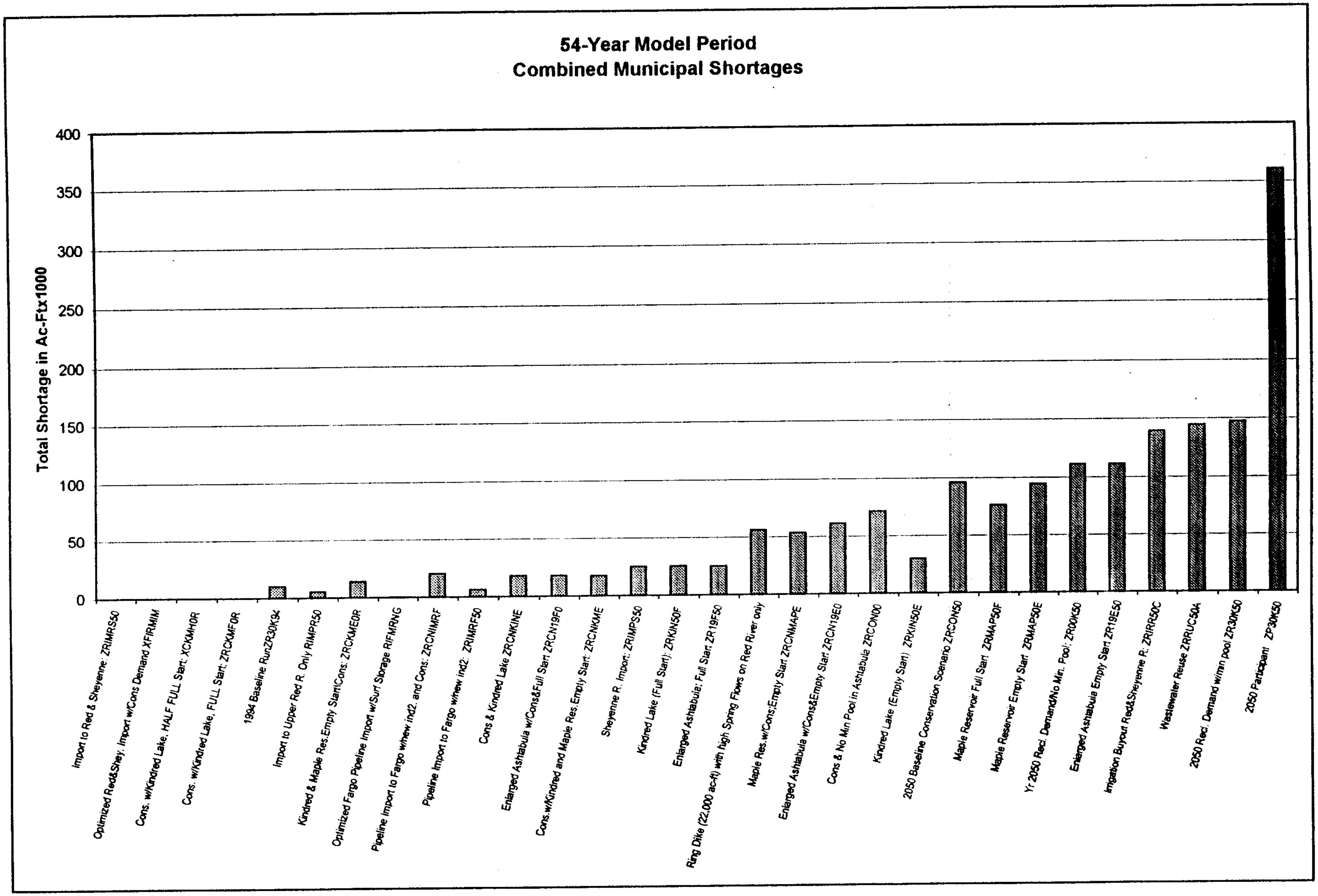

Figure 33: Combined Municipal Shortages - 54 Year Period (by Feature Ranking)

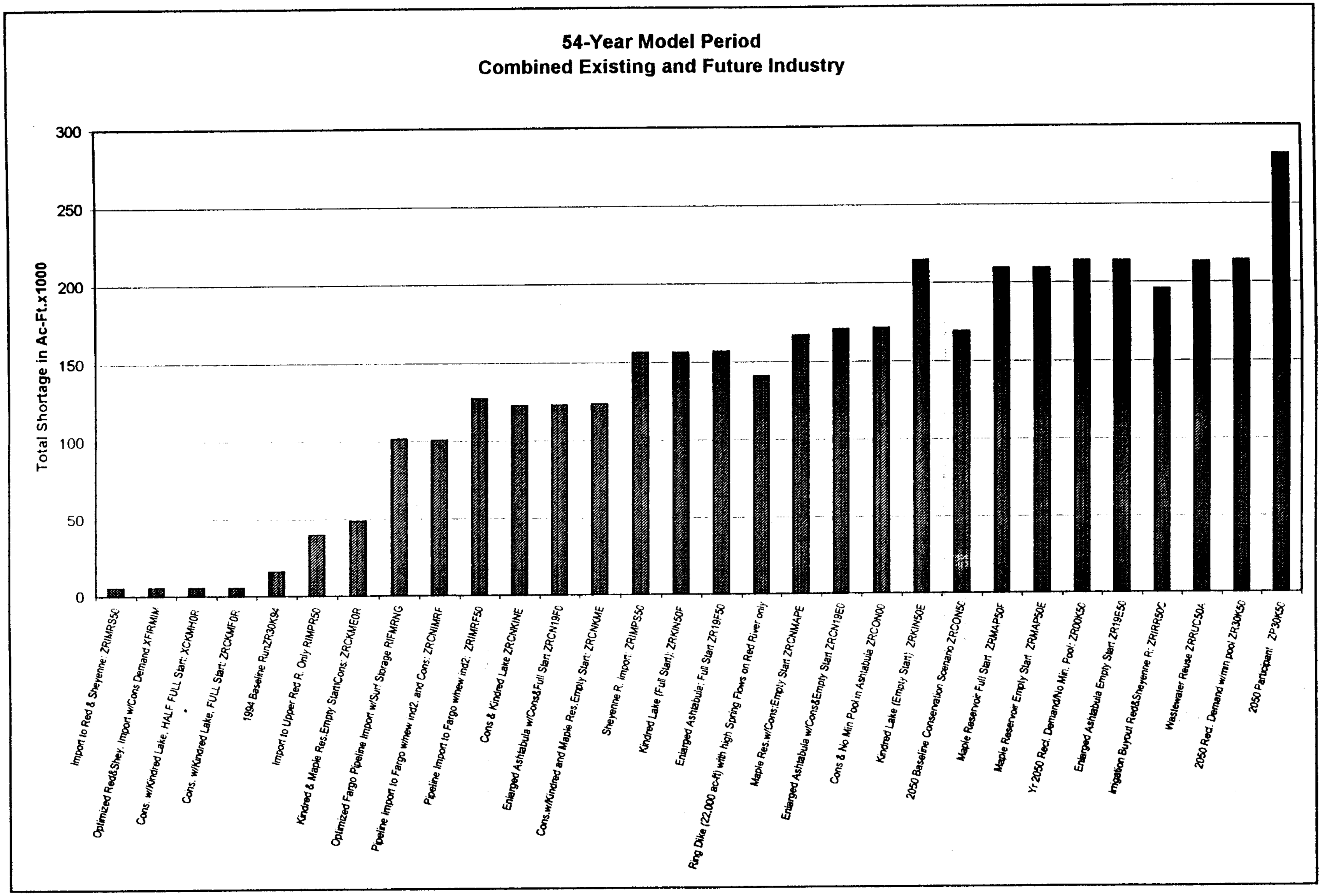

Figure 34: Combined Existing and Future Industry Shortages - 54 Year Period (by Feature Ranking)

Table 156: Total 1931-1941 Drought Period Shortages for each Feature

1931-1941 Drought Period Shortages	Shortages in KAF		
	Total City	Total Industry	Total M&I
Cons. w/Kindred Lake, HALF FULL Start: XCKMH0R	0	2.57	2.57
Cons. w/Kindred Lake, FULL Start: ZRCKMF0R	0	2.64	2.64
Import to Red & Sheyenne: ZRIMRS50	0	2.97	2.97
Optimized Red&Shey. Import w/Cons Demand XFIRMIM	0	2.97	2.97
Import to Upper Red R. Only RIMPR50	5.47	25.93	31.4
Kindred & Maple Res.Empty Start\Cons: ZRCKME0R	14.28	45.9	60.18
Optimized Fargo Pipeline Import w/Surf Storage RIFMRNG	0.39	67.29	67.68
Pipeline Import to Fargo w/new ind2. and Cons: ZRCNIMRF	19.72	66.51	86.23
Pipeline Import to Fargo w/new ind2: ZRIMRF50	5.02	82.86	87.88
Enlarged Ashtabula w/Cons&Full Start ZRCN19F0	17.57	106.84	124.41
Cons.w/Kindred and Maple Res.Empty Start: ZRCNKME	17.36	107.1	124.46
Cons & Kindred Lake ZRCNKINE	18.82	106.22	125.04
Ring Dike (22,000 ac-ft) with high Spring Flows on Red River only	53.26	99.37	152.63
Kindred Lake (Full Start): ZRKIN50F	25.07	128.85	153.92
Sheyenne R. Import: ZRIMPS50	24.69	129.3	153.99
Enlarged Ashtabula; Full Start ZR19F50	24.69	129.62	154.31
Maple Res.w/Cons;Empty Start ZRCNMAPE	53.26	128.27	181.53
Kindred Lake (Empty Start) ZRKIN50E	31.36	159.73	191.09
Enlarged Ashtabula w/Cons&Empty Start ZRCN19E0	61.08	132.18	193.26
Cons & No Min Pool in Ashtabula ZRCON00	70.81	132.7	203.51
2050 Baseline Conservation Scenario ZRCON50	95.67	132.04	227.71
Maple Reservoir Full Start ZRMAP50F	75.87	155.01	230.88
Maple Reservoir Empty Start ZRMAP50E	93.79	155.07	248.86
Yr 2050 Recl. Demand/No Min. Pool: ZR00K50	110.86	159.73	270.59
Enlarged Ashtabula Empty Start ZR19E50	110.97	159.73	270.7
Irrigation Buyout Red&Sheyenne R: ZRIRR50C	138.9	147.56	286.46
Wastewater Reuse ZRRUC50A	143.78	159.87	303.65
2050 Recl. Demand w/min pool ZR30K50	146.76	159.73	306.49
2050 Participant ZP30K50	339.79	181.43	521.22

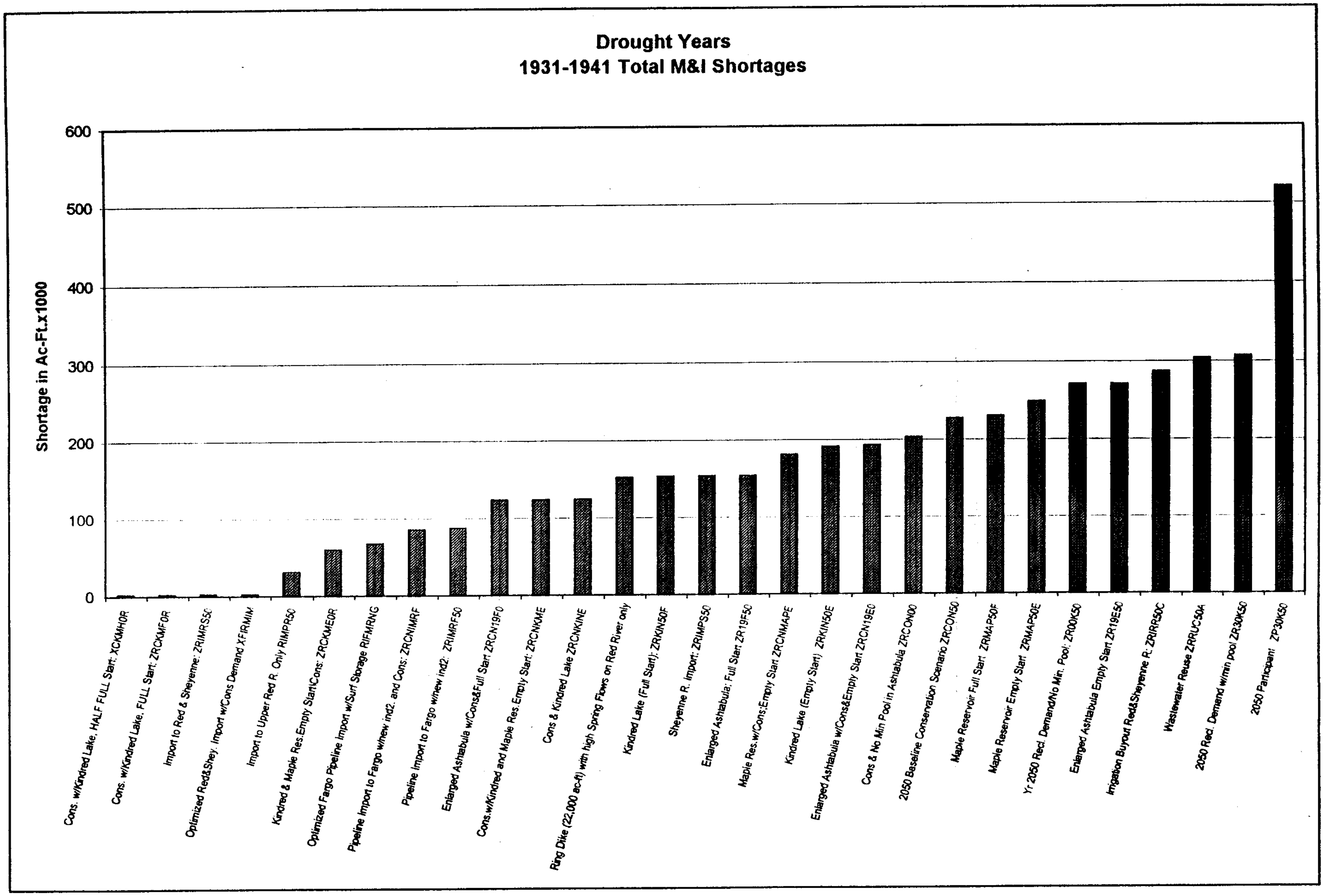

Figure 35: Total Minicipal and Industry Shortages - 1931 to 1941 Drought Period (by Feature Ranking)

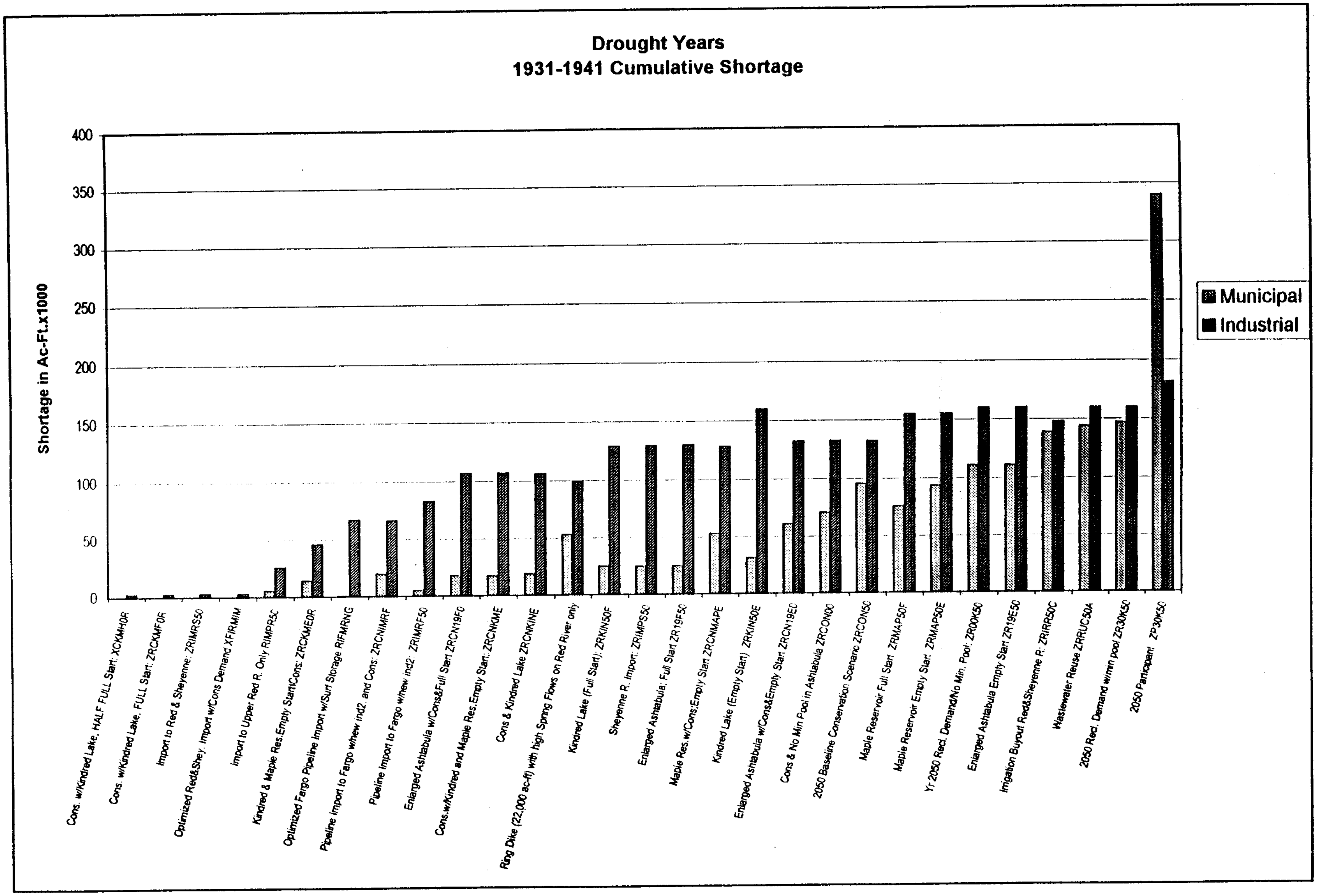

Figure 36: Totals for Municipal and Industry Shortages - 1931 to 1941 Drought Period (by Feature Ranking)

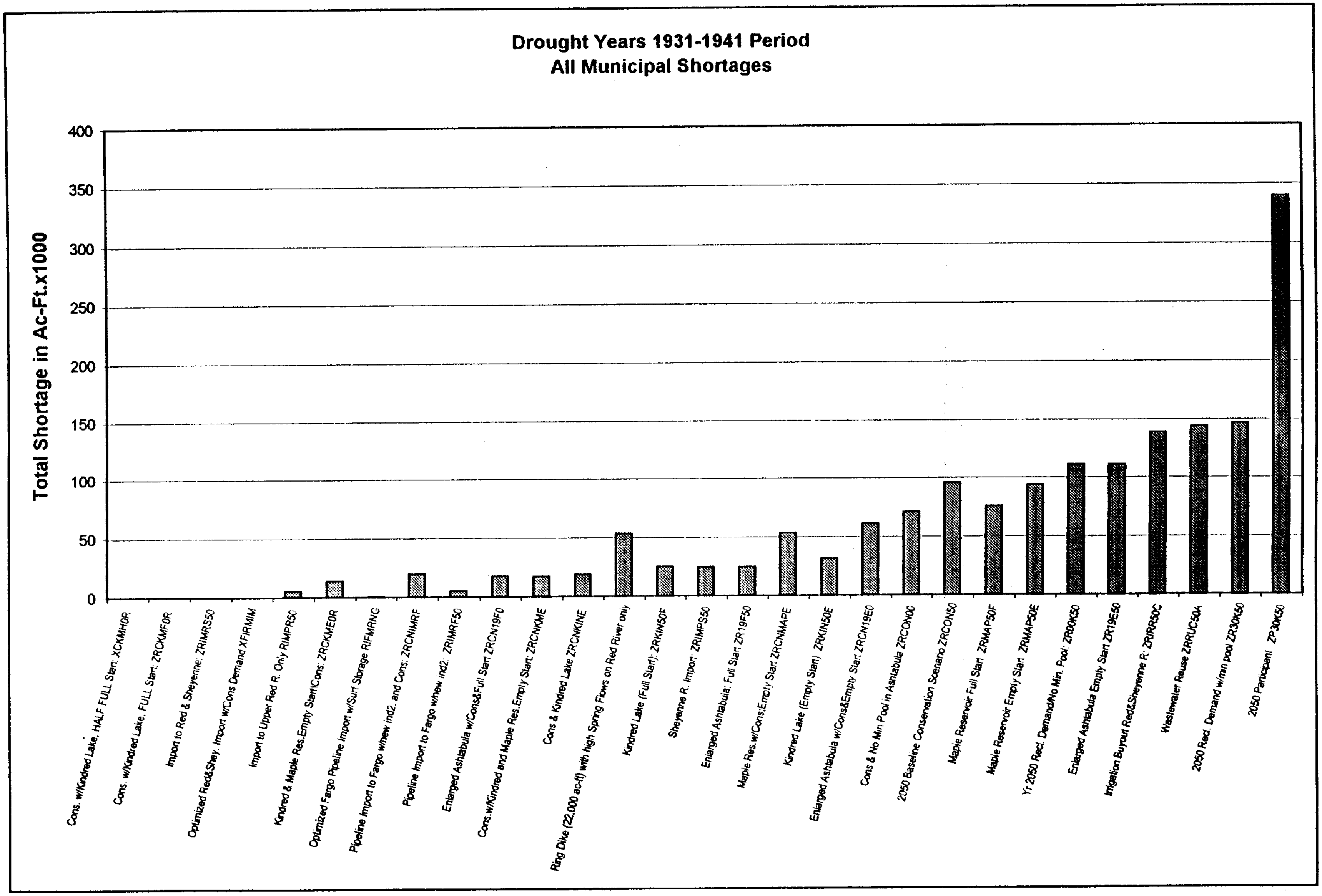

Figure 37: Totals for Municipal Shortages - 1931 to 1941 Drought Period (by Feature Ranking)

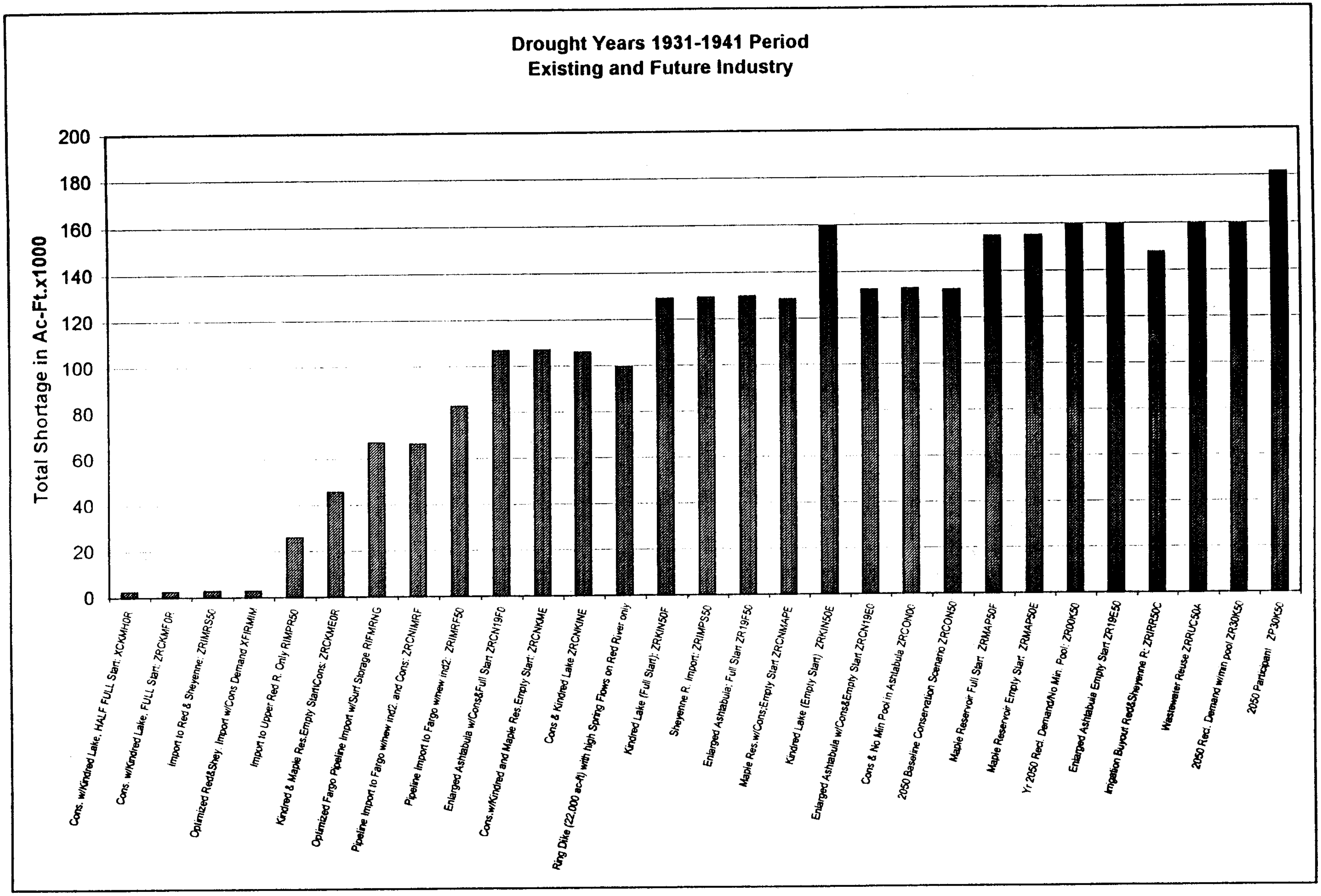

Figure 38: Totals for Industrial Shortages - 1931 to 1941 Drought Period (by Feature Ranking)

Table 157: Action Alternative Simulation Summary, Months above Channel Capacity

Station	Channel Capacity (cfs)	Months above Channel Capacity (1931-1984)							
		Alt1	Alt2	Alt3	Alt4	Alt5	Alt6	Alt7	Alt8
Warwick	600	11	11	11	11	11	11	12	11
Valley City	2,500	3	3	3	3	3	3	4	3
Lisbon	2,250	5	5	5	5	5	5	5	5
Kindred	2,800	1	1	1	1	1	1	2	1
Fargo	3,000	19	19	19	19	19	19	19	19
Halstad	15,000	4	4	4	4	4	4	4	4
Grand Forks	21,000	8	8	8	8	8	8	8	8
Emerson	26,000	11	11	11	11	11	11	11	11

Table 158: Action Alternative Simulation Summary, Lake Ashtabula operation data
Simulated Maximum, Minimum, and Average for Elevation, Surface Area, and Capacity

Action Alternative	Maximum			Minimum			Average		
	Elev. (Feet)	Surface Area (Acres)	Capacity (AF)	Elev. (Feet)	Surface Area (Acres)	Capacity (AF)	Elev. (Feet)	Surface Area (Acres)	Capacity (AF)
Baseline	1266	5300	66600	1257	3373	26300	1265	5222	59530
Alternative 1	1266	5300	66600	1257	3373	26300	1265	5222	59530
Alternative 1R	1266	5300	66600	1257	3373	26300	1265	5222	59480
Alternative 2R	1266	5300	66600	1257	3373	27460	1265	5222	61520
Alternative 3-28B	1275	7700	122600	1257	3373	27590	1272	7200	107850
Alternative 41AR	1266	5300	66600	1257	3373	27220	1265	5222	59400
Alternative 5A1R	1266	5300	66600	1257	3373	30490	1265	5222	62220
Alternative 6R	1266	5300	66600	1258	3500	30790	1265	5222	62260
Alternative 7ABCR	1266	5300	66600	1257	3373	28260	1266	5300	64550
Alternative 7DR	1266	5300	66600	1257	3373	28260	1266	5300	64550
Alternative 8R	1266	5300	66600	1257	3373	26850	1265	5222	60420

Table 159: Action Alternative Simulation Summary of Monthly Flow data

Station	Summary of flows (1931-1984)	Average, Median, Highest, and Lowest Simulated Monthly flow (cfs)								
		Alt1	Alt2	Alt3	Alt4	Alt5	Alt6	Alt7abc	Alt7d	Alt8
Sheyenne River near Warwick, ND	Monthly Average	48.5	48.5	48.5	48.4	48.5	48.5	116..3	116..3	48.5
	Annual Median	39.3	39.3	39.3	39.2	39.3	39.3	106.7	106.7	39.3
	Highest Monthly	1,418	1,418	1,418	1,418	1,418	1,418	1,489	1,489	1,418
	Lowest Monthly	0.0	0.0	0.0	0.0	0.0	0.0	58.7	58.7	0.0
Sheyenne River at Valley City, ND	Monthly Average	110.1	110.1	106.4	119.0	110.0	110.0	174.5	174.5	110.5
	Annual Median	76.5	76.3	73.3	88.6	76.5	76.5	147.3	147.3	76.5
	Highest Monthly	2,885	2,885	2,883	2,894	2,885	2,885	2,955	2,955	2,885
	Lowest Monthly	0.0	0.0	0.0	0.0	3.0	3.0	12.7	12.7	1.0
Sheyenne River at Lisbon, ND	Monthly Average	129.9	129.9	126.2	138.5	129.7	129.7	194.0	194.0	130.3
	Annual Median	89.9	89.9	86.1	102.5	89.9	89.9	163.2	163.2	89.9
	Highest Monthly	3,214	3,214	3,219	3,223	3,214	3,214	3,278	3,278	3,214
	Lowest Monthly	0.0	0.0	0.0	0.0	1.5	1.5	12.7	12.7	0.0
Sheyenne River at Kindred, ND	Monthly Average	158.7	145.2	158.5	166.8	157.9	157.9	222.6	222.6	176.5
	Annual Median	118.5	102.0	105.8	128.4	118.1	118.1	188.2	188.2	135.3
	Highest Monthly	2,985	2,963	2,970	3,013	2,977	2,977	3,072	3,072	3,006
	Lowest Monthly	0.0	2.2	1.4	<1	0.0	0.0	13.0	13.0	0.0
Red River at Fargo, ND	Monthly Average	509.5	502.5	502.5	489.5	553.4	548.4	509.6	509.6	579.1
	Annual Median	348.5	344.2	344.2	329.9	398.2	393.2	348.5	348.5	424.4
	Highest Monthly	9,831	9,829	9,829	9,827	9,883	9,878	9,831	9,831	9,909
	Lowest Monthly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Red River at Halstad, ND	Monthly Average	1,295	1,274	1,292	1,304	1,324	1,344	1,350	1,350	1,350
	Annual Median	1,113	1,084	1,103	1,128	1,172	1,166	1,177	1,177	1,172
	Highest Monthly	20,549	20,392	20,533	20,579	20,597	20,592	20,629	20,629	20,605
	Lowest Monthly	<1	6.5	6.5	6.5	37.9	41.1	18.5	18.5	23.0
Red River at Grand Forks, ND	Monthly Average	2,623	2,596	2,619	2,637	2,671	2,666	2,673	2,698	2,697
	Annual Median	2,209	2,172	2,196	2,226	2,260	2,255	2,258	2,283	2,287
	Highest Monthly	36,081	36,086	36,101	36,114	36,137	36,132	36,134	36,159	36,165
	Lowest Monthly	0.0	4.5	2.9	2.3	33.0	33.0	24.2	49.1	19.1
Red River at Emerson, Manitoba	Monthly Average	3,532	3,506	3,529	3,547	3,580	3,575	3,582	3,608	3,606
	Annual Median	3,139	3,117	3,139	3,161	3,191	3,186	3,197	3,222	3,217
	Highest Monthly	72,351	72,357	72,371	72,384	72,408	72,403	72,404	72,429	72,435
	Lowest Monthly	14.6	30.6	36.1	13.2	42.1	44.6	47.2	72.2	43.0