

Potential Economic Impacts from Groundwater Regulation in the Republican Valley

by

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Executive Summary

The State of Nebraska is required by law to limit consumptive use of water in the Republican Basin to 49 percent of the available supply. This may require reductions in pumping during normal years of 5 to 10 percent, with additional reductions during drought periods. This analysis examines the potential economic impact of such reductions on irrigators and on the Republican Valley economy.

The study uses a linear programming methodology to analyze the on-farm effects and an input-output model to estimate off-farm effects. The on-farm effects were estimated by positing a change in water supply and then computing how a profit maximizing irrigator would respond. The method incorporates five irrigated crops (corn, soybeans, wheat, grain sorghum and alfalfa) and a dryland eco-fallow rotation, and solves for the optimum crops to produce and the optimum amount of water to apply to each crop. Other outputs from the on-farm model include the effect of water supply changes on the total value of crop production, net economic returns, and farm input purchases. These results then feed into an input-output model which computes how the farm level changes affect economic output, value added, and employment for the total regional economy.

Three policy scenarios which encompass the full range of potential regulations were proposed and evaluated, including basin-wide pumping reductions of 10 and 20 percent, and a worst case drought period scenario. The drought scenario consisted of a 13 percent basin-wide reduction in pumping, plus an additional 120,000 acre-feet of pumping reductions (40,000 at the river) that was proportionally distributed across the NRD's based on their respective share of depletions to the river.¹ On-farm economic effects from these scenarios were estimated separately for the Lower, Middle and Upper NRD's and for the upland and quick response wells within each NRD. Off-farm impacts were estimated for a single fifteen county Republican Valley economy that includes the three NRDs and their respective primary trade areas.

It was estimated that a 10 percent reduction in pumping would reduce pumping by 110,000 acre-feet, reduce net farm income by \$3.00 per certified acre per year (\$6.00 per affected acre),² and cost the Republican Valley \$5.6 million. This total cost is equivalent to \$53 for each one acre-foot change in pumping and to \$196 for each one acre-foot change in consumptive use.

It was estimated that a 20 percent reduction in pumping would reduce pumping by 220,000 acre-feet, reduce net farm income by \$15.00 per certified acre per year (\$21.00 per affected acre), and cost the Republican Valley \$24.0 million per year. This total cost is equivalent to \$110 for each one acre-foot change in pumping and to \$254 for each one acre-foot change in consumptive use.

¹ Since this analysis was done the Nebraska Department of Natural Resources has lowered their estimate of the pumping reductions that may be required in drought years from 13 percent basin-wide plus 120,000 acre-feet (40,000 at the river), to a 5 percent basin-wide plus 120,000 acre-feet reduction.

² The cost per certified acre was computed by dividing the total on-farm effects on net income by the total number of certified acres, whereas cost per affected acre was computed by dividing the same total change in net income by the number of acres affected by the regulation. Not all irrigated acres are affected by a regulation because not all of them have historically used more than the regulated amount.

The worst case drought scenario reduced pumping by 260,000 acre-feet, reduced net farm income by \$21.00 per certified acre per year (\$31.00 per affected acre), and cost the Republican Valley \$32.5 million per year. This total cost is equivalent to \$125 for each one acre-foot change in pumping and to \$287¹ for each one acre-foot change in consumptive use.

The 15 county Republican Valley economy produces a total economic output (industry sales) of approximately \$4.4 billion per year and employs over 55,000 people. Basin-wide direct and indirect impacts from the worst case drought scenario (13% and 40,000 acre-feet) would reduce economic output by only 1.5 percent, from about \$4,450 million to \$4,382 million per year, and employment by 1.1 percent, from about 55,000 jobs to 54,375.

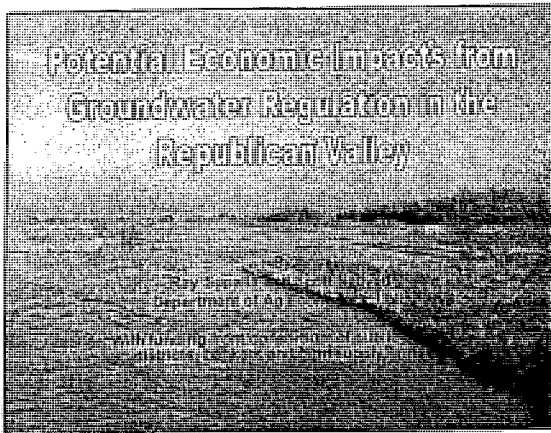
Land values will likely increase slower than they would have without pumping reductions, but an absolute decline in average land values is doubtful. It is important to keep in mind, however, that the impacts on land values depend as much on an unknown market psychology factor as on the economic returns to land, especially in the short-run.

Although the economic effects on some irrigators will be quite significant, the effects on the total regional economy appear to be quite modest when viewed on a percentage basis. Indeed, they were found to be much less than what has been commonly experienced due to annual fluctuations in crop prices or weather induced impacts on crop yields. A 20 percent reduction in pumping, for example, would be roughly equivalent to a 4.7 percent decrease in crop prices when considering only irrigated land. Of course, if pumping reductions occur simultaneously with lower crop prices and/or lower dryland yields the combined effects could become quite significant.

These results were based on an estimate of irrigated acres that is generally referred to by the State as "certified" acres, but the actual number of acres is widely disputed. We accordingly analyzed the sensitivity of the economic results to different acreage estimates for one example case, the Middle Republican NRD. It was found that if actual acres are under estimated by plus or minus 10 percent, and if the error is not corrected when the policy scenarios are implemented, then the estimates in this report understate the true economic impact by approximately the same percentages. On the other hand, if actual acres are over estimated by 10 percent and are adjusted for policy implementation without changing the estimate of baseline pumping, then a lower allocation level will be needed to achieve the same change in pumping. At this lower allocation level, the economic impacts from a 10 percent change in pumping would be 2 to 3 times what was estimated for this report. Alternatively, if actual acres are lower by 10 percent and are adjusted downward without a corresponding change in the baseline pumping estimate, then the cost of implementing the same policy scenarios would be much less than what was estimated herein.

Finally, it is important to keep in mind that this analysis did not consider potential mitigating measures, such as government subsidies for retiring irrigated land, development of a fee hunting industry or other economic development options. Such programs could compensate at least in part for the adverse effects of reduced irrigation.

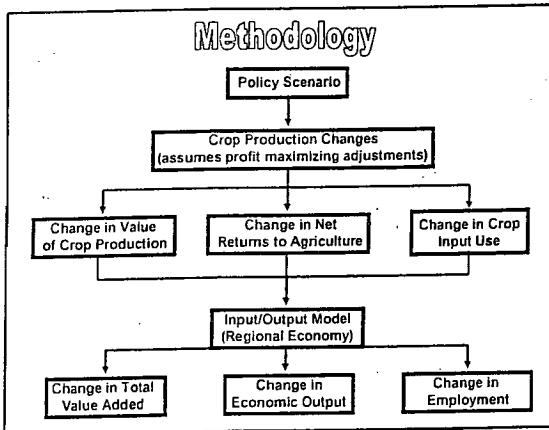
The appended slide presentation provides more detailed information on methods, findings and conclusions.



Purpose

To analyze the on-farm and off-farm consequences of reduced irrigation in the Republican Valley.

To provide economic information for water policy decision making and for general economic planning.



Important Inputs and Assumptions

Irrigated Acres Estimates Used in Analysis

	Certified Acres
Upper Republican	
Upland Sprinkler	368,970
Quick Response - Sprinkler	51,301
Quick Response - Gravity	28,446
Total Upper Republican	448,717
Middle Republican	
Upland Sprinkler	135,169
Upland Gravity	64,243
Quick Response - Gravity	112,588
Total Middle Republican	312,000
Lower Republican	
Upland Sprinkler	132,185
Upland Gravity	36,562
Quick Response - Gravity	161,253
Total Lower Republican	330,000

Baseline Pumpage (1998 - 02 Average)

	Acre-Feet	Inches/Acre
Upper Republican		
Upland - Sprinkler	428,896	13.95
Quick Response - Sprinkler	66,537	15.56
Quick Response - Gravity	37,190	15.69
Middle Republican		
Upland - Sprinkler	134,816	11.97
Upland - Gravity	64,074	11.97
Quick Response - Gravity*	139,045	14.82
Lower Republican		
Upland - Sprinkler	101,713	9.23
Upland - Gravity	28,133	9.23
Quick Response - Gravity*	131,502	9.79

* Includes some sprinkler

Crops Considered

Irrigated






Corn
Soybeans
Alfalfa
Wheat
Grain Sorghum



Dryland (on former irrigated land)

Corn - Fallow - Wheat Rotation

Crop Prices*

Corn	\$2.60	
Wheat	\$3.75	
Grain Sorghum	\$2.52	
Alfalfa	\$74.14	
Soybeans	\$5.50	

* Based on short-term forecast by FAPRI, University of Missouri and Iowa State University.

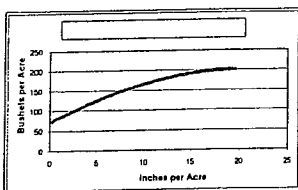
Crop Production and Irrigation Costs

- Based on University of Nebraska Coop Extension Service Budget calculator.
- Costs considered include only items that will be impacted by regulations. Items such as overhead and management charges, land costs and some depreciation is not estimated.
- Irrigation costs based on electric pumps, average lift and pressure requirements.

Irrigation Costs

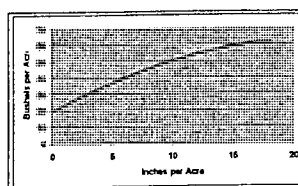
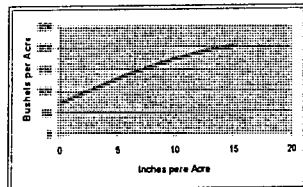
	Feet of Head (Lift & Pressure)	\$/Acre-Inch*
Upper NRD		
Upland Sprinkler	193.5	6.11
Quick Sprinkler	75.9	5.00
Quick Gravity	75.9	3.02
Middle NRD		
Upland Sprinkler	241.7	6.57
Upland Gravity	241.7	4.58
Quick Gravity	112.2	2.92
Lower NRD		
Upland Sprinkler	176.8	5.96
Upland Gravity	176.8	3.97
Quick Gravity	72.1	2.98

*Includes all costs that vary with amount pumped: Energy, Labor, Maintenance, Use Related Depreciation



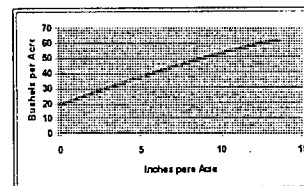
Corn, Middle NRD,
Gravity Irrigated

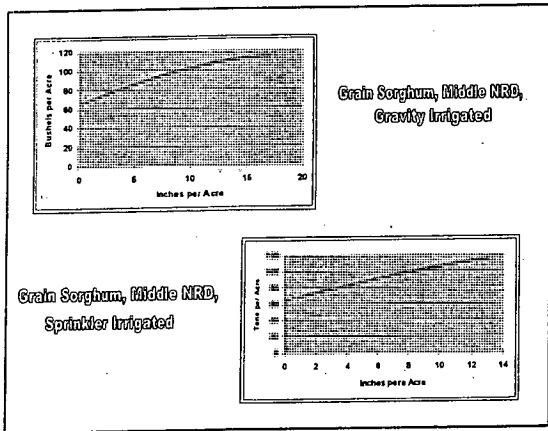
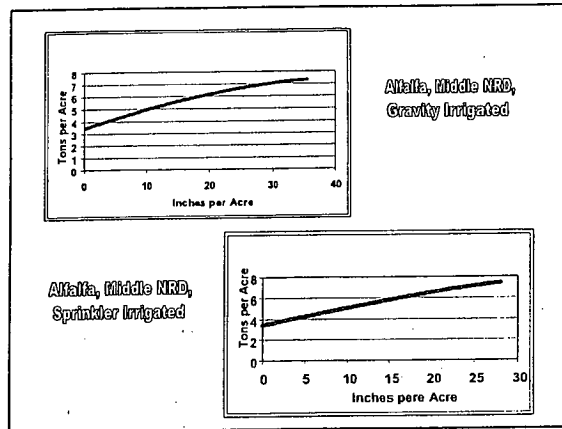
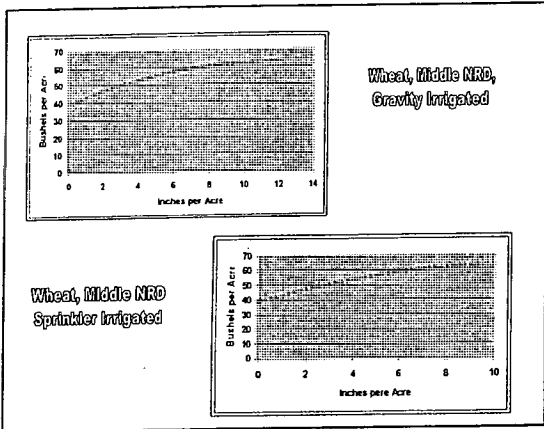
Corn, Middle NRD
Sprinkler Irrigated



Soybeans, Middle NRD
Gravity Irrigated

Soybeans, Middle NRD
Sprinkler Irrigated

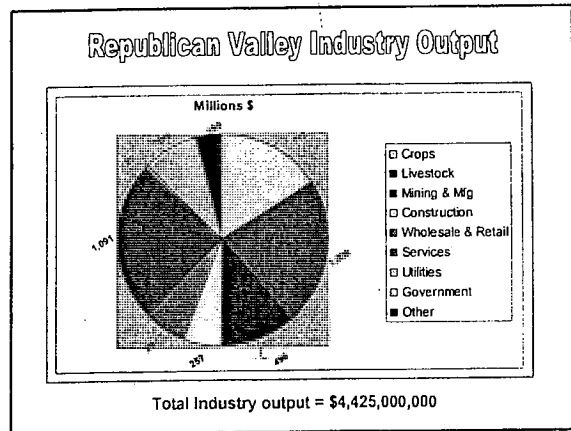


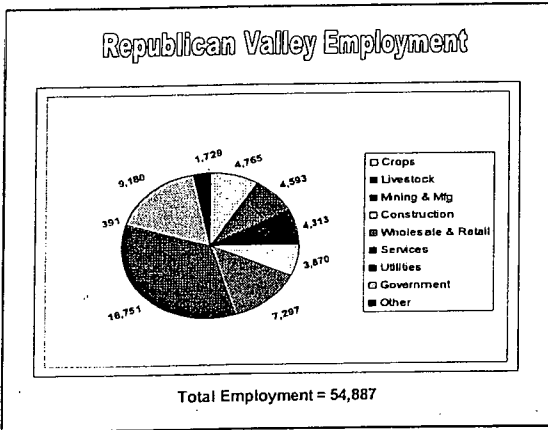


Description
of the
Regional Economy

Republican Valley Economy
(Counties Included)

<p>Chase Frontier Franklin Dundy Furnas Hitchcock Hayes Harlan</p>	<p>Gosper Red Willow Phelps Nuckolls Lincoln Kearney Webster</p>
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Regulatory Scenarios

I. 10% reduction in pumping, all situations
 II. 20% reduction in pumping, all situations

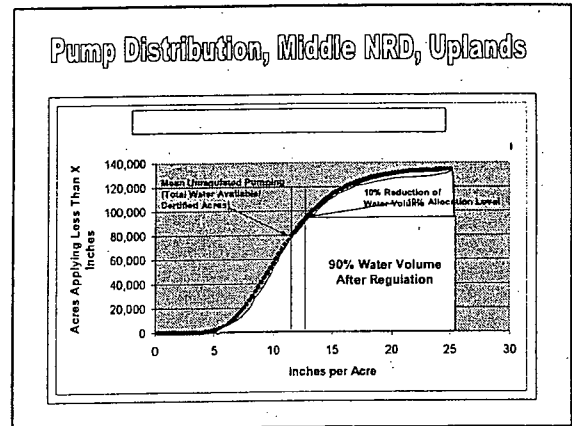
Major Assumptions:

- Administered on 3 to 5 year average to account for rainfall variability.
- Separate allocations for upland and quick response wells.
- Little if any pooling within an ownership unit for Lower and Middle NRD's. Upper continues current policy practices.

Regulatory Scenarios

III. Drought Case

Upper NRD	
Upland-Sprinkler	13% reduction
QRW-Sprinkler	13% reduction + 34,000 acre-feet
QRW-Gravity	13% reduction + 18,800 acre-feet
Middle NRD	
UL-Sprinkler	13% reduction
UL-Gravity	13% reduction
QRW-Gravity	13% + 36,000 acre-feet
Lower NRD	
UL-Sprinkler	13% reduction
UL-Gravity	13% reduction
QRW-Gravity	13% + 31,200 acre-feet



Regulation Levels

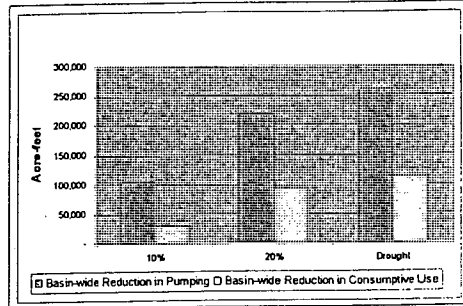
	Inches Per Acre			
	Baseline Average	10%	20%	13% and 40K
Upper NRD				
Upland-Spk	13.95	13.83	11.43	12.92
QRW-Spk	15.56	15.24	12.87	5.38
QRW-Grv	15.69	15.29	12.97	5.97
Middle NRD				
Upland-Spk	11.97	13.17	10.80	12.41
Upland-Grv	11.97	13.17	10.80	13.12
QRW-Grv	14.82	15.86	13.38	9.56
Lower NRD				
Upland-Spk	9.23	10.32	8.32	9.50
Upland-Grv	9.23	10.32	8.32	9.50
QRW-Grv	9.79	10.54	8.94	6.38

Acres Impacted by Regulations

	Percent of Total Irrigated Acres		
	10%	20%	13% and 40K
Upper NRD			
Upland-Spk	59	78	66
QRW-Spk	60	78	100
QRW-Grv	60	78	100
Middle NRD			
Upland-Spk	49	62	53
Upland-Grv	49	62	53
QRW-Grv	52	68	91
Lower NRD			
Upland-Spk	48	63	54
Upland-Grv	47	59	52
QRW-Grv	53	67	88

Results

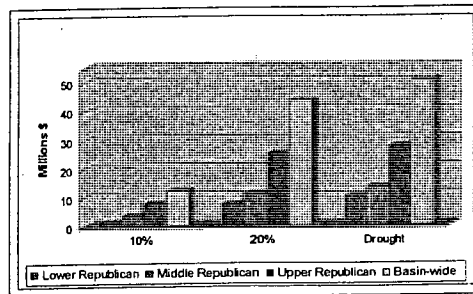
Reduction in Volume Pumped and Consumptive Use



Farm Management Responses to Limited Water

- First: Reduce per acre application to wheat, grain sorghum, and alfalfa significantly.
- Second: Reduce water applied to corn and soybeans slightly, depending on initial starting point.
- Third: Convert wheat and sorghum acres to a dryland rotation
- Fourth: Slight reduction in irrigated corn acres to dryland

Reduction in Value of Crop Production



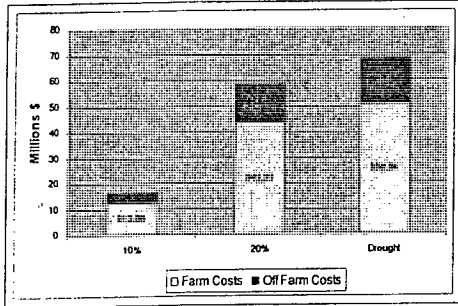
Basin-Wide Changes in Crop Production

	10%	20%	13% and 40K
Corn (bu)	-3,690,935 -2.3%	-15,471,987 -9%	-17,310,278 -11%
Wheat (bu)	2,434 0.1%	885,002 32%	776,414 28%
Grain Sorghum (bu)	-51,205 -4.6%	40,171 4%	100,190 9%
Alfalfa (ton)	-28,423 -8.8%	-78,395 -24%	-93,044 -29%
Soybeans (bu)	-47,170 -0.8%	-129,620 -2%	-323,115 -3%

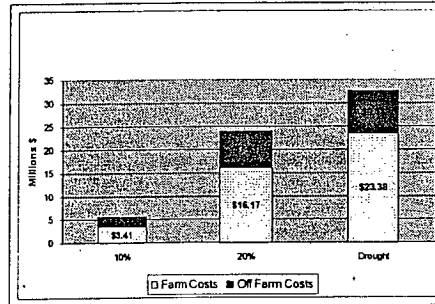
Basin-Wide On-Farm Costs for Pumping Reductions

Scenario	Cost per Irrigated Acre	Cost Per Affected Acre
10%	\$3.00	\$6.00
20%	\$15.00	\$21.00
13% and 40K	\$21.00	\$30.00

Reduction in Economic Output in Republican Valley Economy



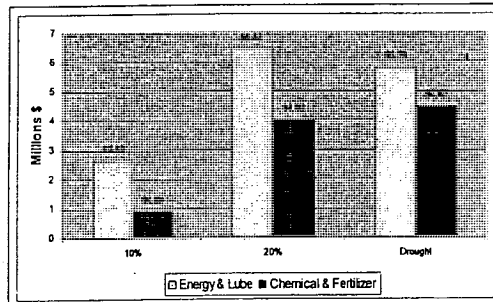
Reduction in Value Added in Republican Valley Economy



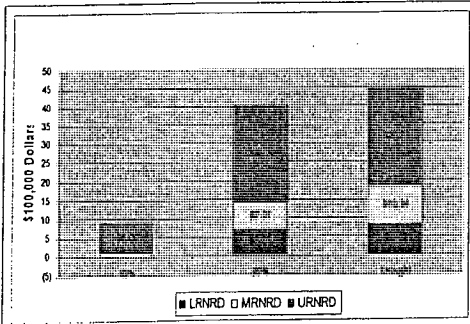
Employment Impacts

- Basin-wide employment impacts range from 150 jobs for the 10% scenario to over 600 for the worst case drought scenario.
- Total employment in the regional economy is over 55,000. Hence, even the worst case impact is only 1.1 percent of the total.

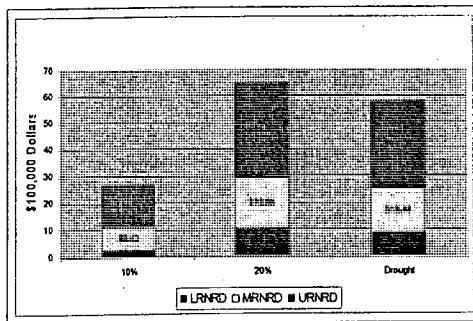
Reduction in Farm Input Use in Republican Valley



Reduction in Chemical & Fertilizer Costs Per NRD



Reduction in Energy & Lube Costs Per NRD



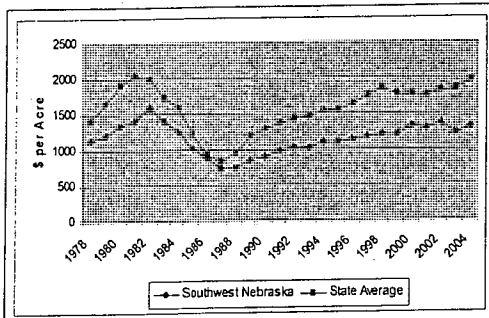
Land Value Impacts

Impact on Land Values

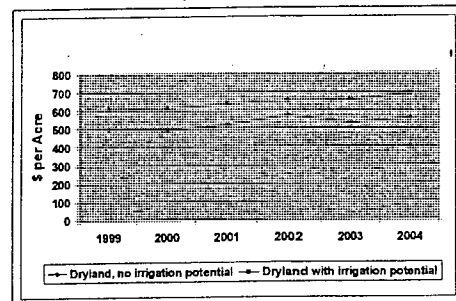
Factors to Consider:

1. Changes in net returns to irrigated land.
2. Limits on new well development.
3. Inflation and productivity trends.
4. Market psychology.

Irrigated Land Value Trends



Land Value Trends, Southwest Nebraska



Most Likely Land Value Impacts

- **Dryland with Irrigation Potential:**
 - Likely to decrease by 10 to 15%, but much of this impact may already be reflected in market. (From 1995-2004, value of dryland with irrigation potential in the SW increased by 19%, whereas state average increase was 42%).

Most Likely Land Value Impacts

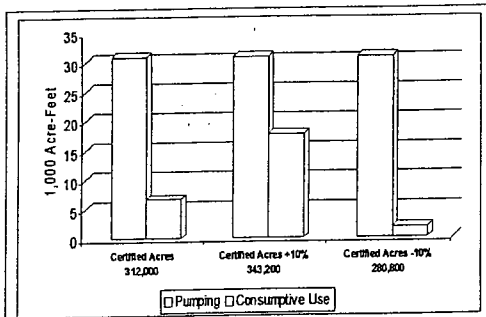
- **Irrigated land values:** The 10% scenario implies an average long-term land value effect of \$75 per acre. A 20% scenario implies \$375 per acre.
- **Absolute land values may not go down –** simply increase at a slower rate.
- **Much depends on community expectations** and on the severity and frequency of drought.

Effect of Different Acreage Estimates on Economic Impacts

Allocation Levels for 10% Reduction in Pumping, Given Varying Acreage Estimates: MRNRD

	Upland Sprinkler	Upland Gravity	Quick Response-Gravity	Total NRD
Certified Acres	135,169	64,243	112,588	312,000
Mean (In/Ac)	11.97	11.97	14.82	12.99
10% Regulation (In/Ac)	13.17	13.17	15.86	14.33
Certified Acres +10%	148,686	70,667	123,847	343,200
Mean (In/Ac)	10.88	10.88	13.47	11.82
10% Regulation (In/Ac)	10.50	10.50	13.65	11.60
Certified Acres -10%	121,652	57,819	101,329	280,800
Mean (In/Ac)	13.30	13.30	16.47	14.44
10% Regulation (In/Ac)	14.60	14.60	20.06	16.12

Effect of 10% Reduction in Pumping on Consumptive Use for Different Acreage Estimates in MRNRD



Effect of Varying Acreage Estimates on Economic Valuation in the MRNRD: 10% Regulation

	Certified Acres	Certified Acres +10%	Certified Acres -10%
Reduction in Net Returns	\$943,923	\$3,327,165	\$172,241
Total Cost/AF Chg Pump	\$30	\$108	\$6
Total Cost/AF Chg ET	\$142	\$188	\$91
Total Cost/Total Acres	\$3.00	\$9.70	\$0.61
Total Cost/Affected Acres	\$6.00	\$14.60	\$1.39

Results From Acreage Analysis

- If actual acres are under estimated by 10%, but are unchanged, then our estimates understate the true economic impact by 10%.
- If actual acres are under estimated by 10% and are changed, then a lower allocation level will be needed to achieve the same change in pumping.
 - At this lower allocation level, the economic impacts from a 10 percent change in pumping will be 2 to 3 times what was estimated using certified acres.

Policy Relevance of Acreage Analysis (Page 1)

- Do results mean that under estimating NRD acres is advantageous to irrigators (lower acres, higher allocation, less economic injury)?
- No, because if allocation per acre is higher it will take a greater reduction in pumping to comply with the Compact?

Policy Relevance of Acreage Analysis (Page 2)

- Do results mean that a higher estimate of NRD acres would be advantageous to irrigators (more acres, lower allocation, more economic injury)?
- No, unless the baseline pumping estimate and/or the required change in total pumping is also adjusted.

Policy Relevance of Acreage Analysis (Page 3)

- Over the long term the real economic impact will depend on how CU needs to change to satisfy the Compact.
- The same total effect on CU, and thus the same economic impact, could be produced in several different ways.

Do Averages Obscure the Pain?

- Yes. Actual injury will vary due to differences in application efficiency, uniformity, soils, management practices etc.
- Those who typically apply less than allocation are not affected at all.
- Those who typically apply much more than allocation are affected only slightly more than average, because net returns per inch decrease as more water is applied per acre.

Potential Mitigation Measures

Economic impacts could be lessened with mitigation measures such as:

- Voluntary land retirement program (public purchase of irrigation rights)
- Alternative land uses
- Education programs to improve irrigation management.

Summary of Results

- The 10% Scenario Will:
 - Reduce pumping by 110,000 AF and consumptive use by 30,000 AF.
 - Cost farmers \$6 per affected acre.
 - Cost farmers \$3 per certified acre.
 - Cost the Republican Valley \$5.6M, which is equal to \$53 per AF change in pumping and \$196 per AF change in consumptive use.

Summary of Results

- The 20% scenario will:
 - Reduce pumping by 220,000 AF and consumptive use by 95,000 AF.
 - Cost farmers \$21 per affected acre.
 - Cost farmers \$15 per certified acre.
 - Cost the Republican Valley \$24.0M, which is equal to \$110 per AF change in pumping and \$254 per AF change in consumptive use.

Summary of Results

- The 13%, 40K drought scenario will:
 - Reduce pumping by 260,000 AF and consumptive use by 113,200 AF.
 - Cost farmers \$31 per affected acre.
 - Cost farmers \$21 per certified acre.
 - Cost the Republican Valley \$32.5M, which is equal to \$125 per AF change in pumping and \$287 per AF change in consumptive use.

Summary of Results

- Basin-wide impacts from the 13%, 40K drought scenario (most severe) would reduce regional output by 1.5% and employment by 1.1%.
- Very recent discussions with state officials suggest that the required normal year reductions in pumping may be closer to 5 than to 10 percent. Drought year reductions likely to be lower also at 5% and 40K instead of 13% and 40K.

Conclusions

- Long-term normal year reduction in pumping of 10 to 15% will significantly affect some individual producers, but will not have devastating effect on the regional economy.
- Adjustments to meet drought conditions will be significant but not devastating at the regional level; unless continued for multiple years.

Conclusions

- Crop prices can substantially mitigate or exacerbate regulatory impacts. For example, the effect on irrigators (basin-wide) of a 20% decrease in pumping is roughly equivalent to a 4.7% decrease in crop prices.
- Impacts on grain handling and farm supply firms likely to be less than what has been experienced in recent years from crop shifts (corn to soybeans) and technology (Round-up Ready, Bt corn, etc.), except perhaps for a sustained drought scenario.

Conclusions

- Land values will increase a little less in future years than they would have without regulations, but an absolute decline in the property tax base is unlikely.
- Regulations based on percentage reductions in pumping across NRD's have differential impacts on a per acre basis, i.e., those in the URNRD pay more than those in the Middle or Lower NRD's.

Conclusions

- Economic impacts will be quite different if:
 - Mitigation measures are implemented.
 - Certified Irrigated acres are erroneous.
 - Baseline pumpage is erroneous.
 - Crop prices are higher or lower.

Conclusions

- There is no easy way for Nebraska to meet Compact requirements, but perhaps this economic information can help the NRD's and the State make the hard choices.

***** Thanks for Listening *****