



Mike T  
12/5/05

## WATER SUPPLY FOOTNOTES

- 1) Expand CREP to 70,000 Acres – This is a work in progress
- 2) Pumping Ground Water Wells Directly into Creeks
  - Assumptions: \$52-\$57 / AF Diesel Pumping Cost
  - \$40-\$44 / AF Electric Pumping Cost
  - 80% transit loss (20% arrives at Guide Rock in season)
  - Used adjusted pumping rates from GW Model
  - Wells were outside of quick response area
  - Areas a and b are below Harlan, area c is above Harlan
  - (a) East Branch Farmers Cr. To Willow Creek (Above Guide Rock) – 179 Wells
    - Total Pumped: 36,000 AF
  - (b) Lower Thompson Creek – 154 Wells
    - Total Pumped: 32,000 AF
  - (c) Spring Cr. To Rope Creek (Above Harlan) – 361 Wells
    - Total Pumped: 78,000 AF
- 3) Targeting EQIP in Quick Response Area
  - Assumptions: State Cost is \$100 per acre
  - (a) Above Harlan (Muddy Cr. To Harlan County Lake)
    - 73,000 Acres
    - Water savings year 1 through year 3: 800, 4500, 6200 AF respectively
  - (b) Below Harlan (Harlan County Lake to Guide Rock Diversion Dam)
    - 43,000 Acres
    - Analyzed with Bostwick Irrigation District On and Off
    - Bostwick “On” Water savings year 1 through year 3: 5800, 7300, 8000 AF
    - Bostwick “OFF” Water saved year 1 through year 3: 5800, 6600, 7500 AF
- 4) State-Owned Wellfield Outside of Republican Basin
  - Assumptions: Water would be Imported, therefore 100% Nebraska’s
  - Little Blue basin is not fully appropriated, would need NRD approval
  - 20 wells would average 1200 GPM and be pumped 90 days
  - One-time Costs:
    - Permanently retire irrigation from 9 sections of land \$5,760,000
    - Drill 20 new wells at \$15,000 per well (250 ft) \$ 300,000
    - 40 mile pipeline at \$200,000 per mile \$8,000,000
    - Annual Operating Costs at \$45 / AF pumped \$ 427,500
- 5) Nebraska Bostwick Does Not Irrigate in 2006
  - Assumptions: Operation and Maintenance would be paid by State on 22,406 acres
  - O&M Cost ???
  - Irrigated to Dryland Cost ???
  - Commitment from State and NRDs to improve water supply outlook
  - Current projection is for 17,000 AF in irrigation pool (10,000 for NE)
  - Superior Canal has been diverting ~5,000 AF natural flow

- 6) Cambridge Canal Does Not Irrigate in 2006, Medicine Creek Fills & Spills  
Assumptions: Operation and Maintenance would be paid by State on 17,232 acres  
O&M Cost \$???  
Irrigated to Dryland Cost \$???  
Commitment from State and NRDs to improve water supply outlook  
Estimated July-Sept. supplement to Rep. Riv: 5,000 AF  
Estimated Oct.-December supplement to Rep. Riv: 10,000 AF  
Estimated 1-year supplement to Rep. Riv: 24,000 - 30,000 AF  
Losses in transit to Harlan during spring and summer could be significant if Frenchman Valley Irrigation District diverts early into Culbertson Canal and dries-up the river
- 7) Reduce Pumping an additional 5% by Regulation + 25% Quick Response Reduction  
Assumptions: Could be done as an on-going dry year lease program
- 8) Remove Vegetation – Currently awaiting information from Bureau of Reclamation regarding Rio Grande management project.

Date: July 18, 2006  
To: Ann Bleed  
From: Derrel Martin  
Re: ET Reduction for Decreases in Pumping

I did the analysis of the amount of reduction in evapotranspiration that would occur if irrigation pumping was reduced by varying amounts for the Upper and Middle Republican NRD's as we discussed a little while back. The analysis is based on the results we used for LB 962 to determine the net irrigation requirements. The results in Table 1 below are based on those values for five weather stations. Note that these data are for corn grown on medium textured soils. I assumed that center pivots would be used and that the application efficiency of the pivot would be 85%.

Based on these values the amount of evapotranspiration reduction that would be expected for varying amounts of pumpage are listed in Table 2 below. The reduction in ET is the difference between ET if irrigated for full yields and for the amount of irrigation water applied.

I hope these data are useful. I was not able to get to this before tonight.

The EXCEL file used to develop the results was included as an attachment in the e-mail message.

Please call or e-mail me if you have questions.

**Table 1. Results of simulations for ET, CIR and net irrigation for NWS weather stations used in the analysis.**  
(from Appendix C. of 2006 Annual Evaluation of Availability of Hydrologically Connected Water Supplies).

| Site          | ET Full Yield, Inches /Year |       | ET Non Irrigated, Inches /Year |       | CIR, Inches /Year | Net Irrigation, Inches /Year |           | Latitude, Degrees | Longitude, Degrees | Station Name | Gross Irrigation, inches | Beta |
|---------------|-----------------------------|-------|--------------------------------|-------|-------------------|------------------------------|-----------|-------------------|--------------------|--------------|--------------------------|------|
|               | 31.25                       | 17.78 | 13.47                          | 14.37 |                   | 40.05                        | -101.53   |                   |                    |              |                          |      |
| BENK          | 31.25                       | 17.78 | 13.47                          | 14.37 | 40.05             | -101.53                      | BENKELMAN | 16.9              | 0.797              |              |                          |      |
| CURT          | 31.22                       | 19.38 | 11.84                          | 13.15 | 40.67             | -100.48                      | CURTIS    | 15.5              | 0.765              |              |                          |      |
| IMPE          | 29.85                       | 18.30 | 11.56                          | 12.67 | 40.52             | -101.63                      | IMPERIAL  | 14.9              | 0.776              |              |                          |      |
| MADR          | 31.45                       | 18.73 | 12.72                          | 13.77 | 40.85             | -101.53                      | MADRID    | 16.2              | 0.785              |              |                          |      |
| MCCO          | 29.05                       | 19.31 | 9.74                           | 11.14 | 40.20             | -100.62                      | MCCOOK    | 13.1              | 0.743              |              |                          |      |
| Average       | 30.56                       | 18.70 | 11.87                          | 13.02 |                   |                              |           | 15.3              | 0.77               |              |                          |      |
| Average URNRD | 30.85                       | 18.27 | 12.58                          | 13.60 |                   |                              |           | 16.0              | 0.79               |              |                          |      |
| Average MRNRD | 30.14                       | 19.35 | 10.79                          | 12.15 |                   |                              |           | 14.3              | 0.75               |              |                          |      |

**Table 2. Reduction in ET for irrigation amounts less than the gross irrigation needed for full yield.**

| Upper Rep. NRD    |              | Middle Rep. NRD   |              |
|-------------------|--------------|-------------------|--------------|
| Irrigation Amount | ET Reduction | Irrigation Amount | ET Reduction |
| inch/yr           | inches/year  | inch/yr           | inches/year  |
| 12                | 2.2          | 11                | 1.5          |
| 13                | 1.5          | 12                | 1.0          |
| 13.5              | 1.2          | 13                | 0.4          |
| 14                | 0.9          | 14                | 0.1          |
| 15                | 0.4          | 14.3              | 0.0          |
| 16                | 0.0          |                   |              |

**Table 4. Results of simulations for ET, CIR and net irrigation for NWS weather stations used in the analysis.**

(from Appendix C. of 2006 Annual Evaluation of Availability of Hydrologically Connected Water Supplies).

For Pivot Irrigation:  
 Applic. Eff. 0.85

| Site          | ET Full Yield, Inches/Year | ET Non Irrigated, Inches/Year | CIR, Inches /Year | Net Irrigation, Inches/Year | Latitude, Degrees | Longitude, Degrees | Elevation, Meter | Climate Division | Station Code | Station Name | Gross Irrigation, Inches | Beta  |
|---------------|----------------------------|-------------------------------|-------------------|-----------------------------|-------------------|--------------------|------------------|------------------|--------------|--------------|--------------------------|-------|
| BENK          | 31.25                      | 17.78                         | 13.47             | 14.37                       | 40.05             | -101.53            | 922              | 6                | c250760      | BENKELMAN    | 16.9                     | 0.797 |
| CURT          | 31.22                      | 19.38                         | 11.84             | 13.15                       | 40.67             | -100.48            | 829              | 6                | c252100      | CURTIS 3 NNE | 15.5                     | 0.765 |
| IMPE          | 29.85                      | 18.30                         | 11.56             | 12.67                       | 40.52             | -101.63            | 999              | 6                | c254110      | IMPERIAL     | 14.9                     | 0.776 |
| MADR          | 31.45                      | 18.73                         | 12.72             | 13.77                       | 40.85             | -101.53            | 975              | 6                | c255090      | MADRID       | 16.2                     | 0.785 |
| MCCO          | 29.05                      | 19.31                         | 9.74              | 11.14                       | 40.20             | -100.62            | 771              | 6                | c255310      | MCCOOK       | 13.1                     | 0.743 |
| Average       | 30.56                      | 18.70                         | 11.87             | 13.02                       |                   |                    |                  |                  |              |              | 15.3                     | 0.77  |
| Average URNRD | 30.85                      | 18.27                         | 12.58             | 13.60                       |                   |                    |                  |                  |              |              | 16.0                     | 0.79  |
| Average MRNRD | 30.14                      | 19.35                         | 10.79             | 12.15                       |                   |                    |                  |                  |              |              | 14.3                     | 0.75  |

**Reduction in ET for irrigation amounts less than the gross irrigation needed for full yield.**

| Upper Rep. NRD            |                          | Middle Rep. NRD           |                          |
|---------------------------|--------------------------|---------------------------|--------------------------|
| Irrigation Amount inch/yr | ET Reduction inches/year | Irrigation Amount inch/yr | ET Reduction inches/year |
| 12                        | 2.2                      | 11                        | 1.5                      |
| 13                        | 1.5                      | 12                        | 1.0                      |
| 13.5                      | 1.2                      | 13                        | 0.4                      |
| 14                        | 0.9                      | 14                        | 0.1                      |
| 15                        | 0.4                      | 14.3                      | 0.0                      |
| 16                        | 0.0                      |                           |                          |

Water Supply Management Options for 2007 and Beyond using Moderate Drought Scenarios to Estimate Savings from Reduced GW Pumping

| Project   | Estimated Annual Yield (AF) - Year 1 | Estimated Annual Yield (AF) - Year 3 | Estimated Annual Yield (AF) - Year 5 | Estimated Annual Yield (AF) - Year 10 | Estimated Annual Yield (AF) - Year 20 | Average Year 1 through Year 10 | Average Year 10 through Year 20 | Acres Affected |
|---|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|--------------------------------|---------------------------------|----------------|
| <b>Current Activities</b>   |                                      |                                      |                                      |                                       |                                       |                                |                                 |                |
| Current Allocations UR, MR, LR NRDs*  | 3,457                                | 4,134                                | 7,889                                | 9,372                                 | 12,707                                | 6,835                          | 11,327                          | 1,041,100      |
| CREP / EQIP   | 4,233                                | 4,998                                | 5,158                                | 6,223                                 | 7,667                                 | 5,492                          | 6,064                           | 44,400         |
| <b>Expand CREP / EQIP</b>   |                                      |                                      |                                      |                                       |                                       |                                |                                 |                |
| CREP Enrollment Goal  | 6,678                                | 8,116                                | 8,258                                | 9,888                                 | 12,153                                | 8,729                          | 11,028                          | 70,000         |
| Expanded Program  | 9,571                                | 11,731                               | 12,056                               | 14,124                                | 17,445                                | 12,563                         | 15,825                          | 100,000        |
| <b>Additional Reductions in Irrigation Pumping in UR, MR, LR NRDs</b>   |                                      |                                      |                                      |                                       |                                       |                                |                                 |                |
| 10% Pumping Reduction   | 1,287                                | 2,631                                | 3,144                                | 4,450                                 | 6,119                                 | 3,170                          | 5,402                           | 1,041,100      |
| 20% Pumping Reduction   | 2,667                                | 5,372                                | 6,364                                | 8,917                                 | 12,294                                | 6,407                          | 10,886                          | 1,041,100      |
| 50% Pumping Reduction   | 6,929                                | 14,070                               | 18,014                               | 28,154                                | 38,336                                | 18,511                         | 33,623                          | 1,041,100      |
| 100% Pumping Reduction  | 13,698                               | 30,682                               | 53,124                               | 68,971                                | 107,753                               | 48,079                         | 92,047                          | 1,041,100      |
| 15% Upland Reduction & Quick Response 25%   | 4,653                                | 9,421                                | 10,877                               | 13,135                                | 18,804                                | 10,309                         | 15,330                          | 1,041,100      |
| 15% Upland Reduction & Quick Response 50%   | 7,443                                | 15,047                               | 18,592                               | 21,006                                | 25,616                                | 17,297                         | 24,191                          | 1,041,100      |
| Reduce Quick Response Pumping 10%   | 1,165                                | 2,424                                | 2,589                                | 3,109                                 | 3,437                                 | 2,508                          | 3,315                           | 291,508        |
| Reduce Quick Response Pumping 20%   | 2,419                                | 5,138                                | 5,489                                | 6,171                                 | 6,954                                 | 5,124                          | 6,641                           | 291,508        |
| Reduce Quick Response Pumping 50%   | 6,302                                | 13,543                               | 15,826                               | 15,641                                | 17,807                                | 14,183                         | 17,310                          | 291,508        |
| Reduce Quick Response Pumping 100%  | 12,476                               | 28,948                               | 45,117                               | 47,511                                | 55,684                                | 38,477                         | 53,927                          | 291,508        |
| <b>Riparian Vegetation Management ("bare soil" est)</b>   |                                      |                                      |                                      |                                       |                                       |                                |                                 |                |
| 10% Phreatophyte Reduction  | 8,374                                | 10,959                               | 10,702                               | 10,992                                | 10,852                                | 10,545                         | 10,741                          | 15,800         |
| 20% Phreatophyte Reduction  | 17,782                               | 23,028                               | 23,423                               | 22,761                                | 22,490                                | 22,303                         | 22,309                          | 31,800         |
| <b>Limited Reaches of Quick Response Area</b>   |                                      |                                      |                                      |                                       |                                       |                                |                                 |                |
| Muddy Creek to Harlan County Lake   | 147                                  | 6,155                                | 7,253                                | 8,210                                 | N/A                                   | 6,504                          | N/A                             |                |
| Harlan County Lake to Guide Rock Diversion  | 3,364                                | 5,189                                | 5,893                                | 8,801                                 | N/A                                   | 6,449                          | N/A                             |                |
| <b>Surface Water Lease</b>  |                                      |                                      |                                      |                                       |                                       |                                |                                 |                |
| Bostwick Irrigation District  |                                      |                                      |                                      |                                       |                                       |                                |                                 | 22,406         |
| Frenchman Cambridge   |                                      |                                      |                                      |                                       |                                       |                                |                                 | 17,232         |
| Frenchman Valley  |                                      |                                      |                                      |                                       |                                       |                                |                                 | 9,292          |
| Riverside Canal   |                                      |                                      |                                      |                                       |                                       |                                |                                 | 652            |
| <b>Stream Flow Augmentation</b>   |                                      |                                      |                                      |                                       |                                       |                                |                                 |                |
| Upstream of Guide Rock (in-basin retiming)  | 5,000                                |                                      |                                      |                                       |                                       |                                |                                 | ?              |
| Above Harlan County Lake (in-basin retiming)  | 5,000                                |                                      |                                      |                                       |                                       |                                |                                 | ?              |
| Supply from Outside of Republican Basin   | 5,000                                |                                      |                                      |                                       |                                       |                                |                                 | ?              |
| Re-regulating Dams to provide timely irrigation supply above or below Guide Rock (storage could be from local streams or imported from outside basin) |                                      |                                      |                                      |                                       |                                       |                                |                                 | N/A            |
| Supplement Virgin Water Supply or Bostwick Irrigation   |                                      |                                      |                                      |                                       |                                       |                                |                                 | N/A            |

\* Current Estimated Certified GW Acres = 1,085,500  
After CREP / EQIP there are 1,041,100 certified acres

5 years

Expand ~~Current~~ CREP 10% 8,200 AF 10,700 AF

Acres in COST

|    |       |        |       |
|----|-------|--------|-------|
| LR | 97-01 | 01-05  | 97-05 |
|    | 33606 | 37600  | 71200 |
| MR | 28900 | 41400  | 71900 |
| UR | 7000  | 6900   | 13900 |
|    |       | 69700  | 85900 |
|    |       | 157000 |       |

Achieve to date Alloc 7700  
CREP/EQIP 5100  
est allo 2006 = 185,000

Marc's calculations using IMP Planning Acreage

| Acres Added COHYST 2001-2005 |           | Acreage   |           |         | Assuming equal distribution |           |     |         |                                  |
|------------------------------|-----------|-----------|-----------|---------|-----------------------------|-----------|-----|---------|----------------------------------|
| 1997-2001                    | 2001-2005 | 1997-2005 | 1997-2005 | QRW     | Upland                      | Total     | %QR | %Upland | Num acres added in each area sir |
| URNRD                        | 7,000     | 6,900     | 13,900    | 55,000  | 400,000                     | 455,000   | 12% | 88%     | 834                              |
| MRNRD                        | 28,800    | 41,400    | 71,900    | 90,000  | 200,000                     | 290,000   | 31% | 69%     | 12,848                           |
| LRNRD                        | 33,600    | 37,600    | 71,200    | 120,000 | 157,000                     | 277,000   | 43% | 57%     | 16,289                           |
| Total                        | 69,400    | 85,900    | 157,000   | 265,000 | 757,000                     | 1,022,000 |     |         | 21,311                           |

Acres Added COHYST 2001-2005

| 1997-2001 | 2001-2005 | 1997-2005 |
|-----------|-----------|-----------|
| URNRD     | 7,000     | 6,900     |
| MRNRD     | 28,800    | 41,400    |
| LRNRD     | 33,600    | 37,600    |
| Total     | 69,400    | 85,900    |

Target Pumpage Volumes

| URNRD  | MRNRD  | LRNRD  |
|--------|--------|--------|
| 13,000 | 20,000 | 24,000 |

Inches per Acre Allocation

| QR  | QR  | Upland | Upland |
|-----|-----|--------|--------|
| 2.8 | 5.7 | 11.3   | 11.4   |
| 2.7 | 5.3 | 9.0    | 10.5   |
| 2.4 | 4.8 | 9.6    | 11.1   |

Inches per Acre Allocation

| QR  | QR  | Upland | Upland |
|-----|-----|--------|--------|
| 2.8 | 5.7 | 11.3   | 11.4   |
| 2.7 | 5.3 | 9.0    | 10.5   |
| 2.4 | 4.8 | 9.6    | 11.1   |

Inches per Acre Allocation

| QR  | QR  | Upland | Upland |
|-----|-----|--------|--------|
| 2.8 | 5.7 | 11.3   | 11.4   |
| 2.7 | 5.3 | 9.0    | 10.5   |
| 2.4 | 4.8 | 9.6    | 11.1   |

Allocation

| CO      | KS     | NE      | Total   |
|---------|--------|---------|---------|
| 2003    | 21,420 | 167,780 | 227,580 |
| 2004    | 21,540 | 137,450 | 205,630 |
| 2005    | 25,040 | 136,820 | 199,450 |
| Average | 22,667 | 147,350 | 210,887 |

Allocation

| CU     | CO     | KS     | NE     | CU-Credit |
|--------|--------|--------|--------|-----------|
| 33,470 | 33,670 | 35,460 | 34,200 | 262,780   |
| 33,670 | 33,670 | 35,460 | 34,200 | 252,650   |
| 35,460 | 35,460 | 34,200 | 34,200 | 253,740   |
| 34,200 | 34,200 | 34,200 | 34,200 | 256,390   |

Allocation

| CU     | CO     | KS     | NE     | CU-Credit |
|--------|--------|--------|--------|-----------|
| 33,470 | 33,670 | 35,460 | 34,200 | 262,780   |
| 33,670 | 33,670 | 35,460 | 34,200 | 252,650   |
| 35,460 | 35,460 | 34,200 | 34,200 | 253,740   |
| 34,200 | 34,200 | 34,200 | 34,200 | 256,390   |

Percent of Allocation

|    |     |     |      |
|----|-----|-----|------|
| 6% | 39% | 55% | 100% |
|----|-----|-----|------|

Percent of Allocation

|    |     |     |
|----|-----|-----|
| 9% | 64% | 73% |
|----|-----|-----|

Allocation

|         |         |        |         |
|---------|---------|--------|---------|
| 147,350 | 102,844 | 44,506 | 133,518 |
|---------|---------|--------|---------|

Allocation

|         |         |        |         |
|---------|---------|--------|---------|
| 147,350 | 102,844 | 44,506 | 133,518 |
|---------|---------|--------|---------|