Water Availability and Outlook Subcommittee Report
Accumulated for the Nebraska Climate Assessment Response Committee
Presented 2/27/06

Current Conditions

In terms of Agricultural interests, the period beginning October 1 and running through April 30 represents our soil recharge period. The amount of moisture during this time frame ultimately determines the degree of drought risk crops will be exposed to during the growing season. There has been is a large variance in the amount of precipitation received across the state, with some areas having surplus moisture, while other areas have been exceptionally dry.

Since October 1 there have been four major precipitation events across the state. An early October storm brought 2-4 inches of moisture to the southern Panhandle and southwestern corner of the state. A strong blizzard developed across the central and northern Plains immediately after Thanksgiving. Major moisture fell across the southwest, central, and northeast Nebraska. Upwards of two feet of snow were recorded across the eastern Sandhills, with liquid equivalent moisture in the range of 0.50 to 2.00 inches. Another system dropped moisture across portions of southeastern Nebraska during the later half of January with totals in the 0.30 to 0.60 inch range. Finally, a strong snow event dropped up to a foot of snow across the central and northern Panhandle, as well as the western Sandhills. Liquid equivalent moisture from this storm was in the 0.40 to 0.60 inch range across areas impacted by heavy snowfall.

Since October 1, areas of the state with positive precipitation departures include the southern Panhandle, southwestern and northeastern Nebraska, as well as a small area centered around Lancaster county. Areas of the state with significant precipitation departures include south central, southeast, and portions of east central Nebraska mainly south of Interstate 80. Two additional pockets of concern include portions of west-central Nebraska centered around North Platte and the northern 1/3 of the Panhandle. Remaining areas of the state are showing dry conditions, but are only slightly on the dry side of normal.

Statistical analysis of precipitation for selected locations across the state during the 10/1 - 2/25 period indicates the wide variation in precipitation trends. For Lincoln, 6.29 inches of moisture has been received during the period, representing the 60th wettest period out of 80 years of valid data. This puts the period at the 60% probability level (with 1 = driest and 99 = wettest). The following list includes the station, precipitation received in inches, ranking out of years available (low value dry, high value wet), and probability level: Omaha (3.34, 8/58, 15%); Norfolk (5.77, 44/58, 78%); Columbus (3.72, 31/102, 31%); Grand Island (4.20, 53/100, 49%); Red Cloud (2.82, 28/100, 25%); McCook

(4.13, 58/81, 78%); North Platte (1.80, 14/57, 17%); Valentine (1.61, 9/57, 19%); Chadron (1.95, 18/83, 26%); Scottsbluff (3.62, 82/101, 78%); Sidney (4.36, 78/87, 92%).

Soil Moisture

Temperatures during the period have been exceptionally warm, with only the mid-November through mid-December and mid-February period experiencing below normal temperatures. From late December through early February over 50 consecutive days of above normal temperatures were recorded for all weather reporting sites in Nebraska. January temperatures average a full 8-12 degrees above normal for Nebraska. These temperatures resulted in no frost layer within soils across the state, and coupled with little precipitation activity, increased surface drying during January.

High Plains Climate Regional Climate Center soil moisture monitoring sites indicate that many sites across eastern Nebraska are at historical minimums, while western sites are at historical maximums. Only stations with at least five years of data were examined. All monitoring sites are over grass and may not be representative of conditions under fields dedicated to row production. Cultivation practices, field slopes, and residual crop cover can have a dramatic influence on soil moisture when compared to grass.

A further investigation into the dry soil moisture readings across eastern Nebraska indicate that abnormally warm conditions into mid-November increased water demand of cool season grass species. Minimum temperatures were insufficient to promote senescence. Therefore, soil moisture monitoring sites across eastern Nebraska showed a marked decrease in reserves, even with several moisture events. Western Nebraska reserves increased as native warm season species did enter senescence and did not require moisture for continued growth.

Soil moisture studies conducted at Mead, Nebraska in the early 1990's found that approximately 70% of the moisture received during the October-April period was captured in the soil profile. Therefore, if 10 inches of moisture was received for the period, then a total of 7 inches is available in the soil profile for roots to use during the growing season.

Using this precipitation/soil moisture relationship, most of the eastern 1/3 of Nebraska has between 2.50 and 3.50 inches of available moisture stored in soil profiles. Areas immediately surrounding Lancaster county, as well as northeastern Nebraska have between 4.00 and 5.00 inches of water. The central 1/3 of the state has 1.50 to 2.50 inches of available moisture. Over the western

1/3 of the state, the southern Panhandle and southwestern corner have 2.50 to 3.50 inches of available moisture, while the northern Panhandle has 0.75 inches to 2.50 inches of moisture.

If normal moisture is received during the next two months, soil moisture values will increase by 4 inches across the eastern 1/3 of the state, while the western 2/3 of the state will see increases of 3-4 inches. The probability that deficits incurred in precipitation from October-February across south central, southeast, and east central Nebraska can be alleviated during the next two months range from 15% over south central Nebraska to 35% over the southeast. The Sandhill region has a 25-40% chance of erasing deficits, while the northern Panhandle has a 15-25% chance of erasing accumulated deficits.

Areas of the state with above normal moisture during the October-February show above normal chances for normal precipitation during the October-April period. Over the southern Panhandle and southwestern corner of the state, there is a 60-80% likelihood of receiving normal moisture for the period, while the northeastern corner of the state has a 55-70% chance of receiving normal precipitation. The above normal area around Lancaster county has a 60-70 percent chance of receiving normal precipitation for the October-April period.

The above described probabilities are based upon a minimum of 80 years of climate data for individual locations. The calculation looks at the accumulated precipitation that has occurred during the October-February period and the additional precipitation needed during March and April to bring the October-April period back to normal. A distribution of the March-April moisture at individual locations was investigated and quantity need was assigned its place within the overall distribution pattern.

Snowpack

Snow-pack levels across the central and northern Rockies has shown significant improvements during the 2005-06 winter as compared to the 2004-05 winter. Much of this region has surplus snow-pack and stream flow projections are calling for above normal flows during the spring and early summer. The Platte river basin in northern Colorado, as well as south central and southeast Wyoming have remained above normal for the entire winter.

Current projections of snow-pack levels, which reach their statistical peak in mid-April, call for levels within the Platte basin to average 120-150% of normal. Stream flow projections are for rates of 110-140% of normal during the April-June period. Deep snow levels in north-central Colorado could lead to localized flooding depending on how rapidly the snow melts this spring. All projected forecasts assume normal precipitation distributions for the remainder of the

winter. Above normal or below precipitation during the upcoming 45 days could increase or decrease these projections, respectively.

Conversations with Wyoming and Colorado officials indicate that a positive tone exists in regard to the snow-pack within the Platte river basin. Municipalities in Denver indicate that water restrictions for 2006 are unlikely as the current snow-pack is sufficient to fill reservoirs to adequate levels, with the possibility that the southern branch of the Platte will see higher flows through the early summer in comparison to rates seen during the past few years.

Within the northern branch of the Platte, projections are that 1.2 million acre-feet of runoff are expected. The Platte watershed reservoirs in Wyoming hold about 2 million acre-feet a full pool. If full irrigation allocations are delivered to Wyoming and Nebraska Panhandle irrigators, then 200,000 acre-feet of water will be added to Wyoming reservoirs by the end of the 2006 productions season. It is unlikely that the reservoirs will completely fill this year, unless significant moisture events blanket the region for the next two months. With proper conservation and water limits, the Wyoming reservoir system could reach full pool with at couple more winters like this year.

Reservoir Levels and Projected Irrigation Releases

Lake McConaughy continues to show improvement over is fall 2004 low of 18% of capacity. As of February 25, the elevation stood at 3217.3 feet above sea level, compared to 3212.2 feet above sea level at this time in 2005. Currently Lake McConaughy holds 638,000 acre-feet of water, compared to 552,000 acre-feet last year at the same time. The lake is currently at 36% of capacity and should increase throughout the spring. The amount of rise in the lake will depend on conservation methods employed to minimize water releases, the amount of spring precipitation events, and snowfall east of Casper, Wyoming.

Water release projections for Lake McConaughy users are projected to be 8.4 inches per acre of deliverable water. This forecast was updated in October and increased from the September forecast of 6.7 inches. There have been no additional changes from the October forecast and none should be expected until there is a clear understanding of the contribution that spring inflows will have on the amount of water stored within McConaughy.

No final determination on the extent of irrigation allocations to western Panhandle users has been made by irrigation district managers. Although projections are that runoff projections could should provide enough water to deliver full allocations, conservation tools may be used used to increase reservoir storage levels in Wyoming as an offset to some of the declines that were experienced during the past 5 years. Fully appropriated releases to Panhandle

producers could increase stream flow rates into McConaughy during the summer as it would lessen the demand on groundwater extraction to compensate for decreased surface water deliveries. Therefore, some of the groundwater would have a chance to move laterally and increase alluvial aquifer

Republican river basin irrigators are facing another dismal year in terms of deliverable irrigation water. Current projections are for 1.5 inches of deliverable water to Harlan reservoir users, 0.50 inches for Enders reservoir users, 6.0 inches for Trenton/Hugh Butler users, and 8.0 inches for Cambridge users.

Since the Republican river basin has no mountain snow-pack acting as its primary flow source, it is entirely dependent on snow storm activity in east central Colorado, as well as ample rainfall during remainder of the year within the entire basin. It will take at least several years of above normal precipitation and strict ground water management to repair the cumulative damage from this 6 year drought. The only way that individual reservoirs within the basin will recover to normal levels would be from the onset of a major precipitation event that would result in flash flooding of the magnitude seen around the Grand Island area last spring.

Weather Outlook

The winter season has been unusually warm and quite dry across portions of eastern Nebraska. That is especially true of the southeast which missed out on the two significant snows that hit the eastern part of the state. It should be noted that the winter does not normally yield much precipitation with normals less than 2 inches for December, January and February combined. Statewide, these three months contribute less than 10% of the average annual total. The western part of the state received greater than normal precipitation, but not nearly enough to offset the deficit that had developed the past few years.

The warm weather likely caused topsoil to lose moisture at a much greater than normal rate this season since the ground was not frozen for long periods. Spring rains could compensate for that fairly quickly. The drought monitor has the most dire conditions over Texas and Oklahoma. There is concern that this area could spread north to Nebraska if the general pattern does not transport sufficient gulf moisture into the state.

There aren't clear jet stream pattern signals at this time, but there is certainly some reason for concern. The CPC outlook of below normal precipitation for May, June and July would worsen the moderate to severe drought conditions we are currently experiencing. At present the greatest concern in eastern Nebraska is for the southeast corner generally east of a line from Omaha to Lincoln and Beatrice, across south central Nebraska, and across the northern Panhandle.

It is also important that the seasonal forecast with the maximum area of probable dry anomaly for the central Plains is during May - July. If below normal moisture does occur during the April-June period, drought risk across the central U.S. increases significantly. Above normal moisture during April-June could provide sufficient sub-soil moisture reserves to alleviate potential stress conditions due to below normal precipitation in July and August.

A cool, wet anomaly from the northern Plains to the upper Great Lakes is currently well developed. This suggests that a likely scenario is for adequate moisture in the early to mid-spring, which could be curtailed prematurely in June by having the polar front make an early push northward into the northern Plains, leaving us on the warm, dry side.

There is a neutral indication for temperatures during the April-June period. We will probably be in a frontal zone for much of the time, yielding poor seasonal predictability for temperatures. On the other hand, we have certainly seen a lot of warm winter weather, assisted by dry soils. This trend should be expected to continue until we start receiving adequate spring rains.

It is risky to mid-winter circulation patterns into the growing season. We can expect at least two major shifts. The first will be the breakdown of the subtropical jet, which typically has its maximum development in February and March, but can last well into the spring. Until this happens, we can expect mild and dry weather overall. Afterwards, the central Plains will be open to Gulf moisture and abundant rainfall, both frontal and from migrating cyclonic disturbances. This will be our window of opportunity to make up for any deficits in soil moisture. As mentioned above, this window closes when the polar front jumps into the northern Plains, which most often happens sometime between late June and mid July.

If enough snow pack remains across the central and northern Rockies, localized convective development tends to increase. It is not uncommon to see these events move across the western 1/3 of the state on a regular basis during the early summer. There eventual movement to the east and impact on eastern Nebraska moisture depends on the amount of moisture transported north from the Gulf of Mexico. If it is sufficient, then these storms can be long lived. If the atmosphere doesn't contain a lot of moisture, these thunderstorm tend to die out before impacting eastern