5.0 BLUE RIVER BASINS

5.1 Summary

Based on the analysis of the sufficiency of the long-term surface water supply in the Blue River Basins, the Department has reached a preliminary conclusion that the basins are not fully appropriated. The Department has also determined that, if no additional legal constraints are imposed on future development of hydrologically connected surface water and groundwater and reasonable projections are made about the extent and location of future development, this preliminary conclusion would not change to a conclusion that the basin is fully appropriated, based on current information.

The analysis of lag effects of current development for areas in the western portion of the Big Blue River Basin indicates a reduction in streamflows by 26 cfs in twenty-five years. The analysis of lag effects of current development for areas in the western portion of the Little Blue River Basin indicates a reduction in streamflows by 26 cfs in twenty-five years. It was not possible to calculate lag effects of current development for areas in the eastern portions of the basins at this time due to the glaciated nature of the area and the fact that the principal aquifer is absent or very thin (CSD, 2005).

The analysis of the impacts of potential future development in the western portion of the Big Blue River Basin, based on current development trends, indicates an additional reduction in streamflows of 4 cfs in twenty-five years. The analysis of the impacts of potential future development in the western portion of the Little Blue River Basin based on current development trends indicates an additional reduction in streamflows of 9 cfs in twenty-five years. The potential impacts of future development in the eastern portions of the basins were not evaluated at this time due to the glaciated nature of the area and the fact that the principal aquifer is absent or very thin (CSD, 2005).

5.2 Basin Descriptions

The Blue River Basins in Nebraska include all surface areas that drain into the Big Blue River, the Little Blue River, and all aquifers that impact surface water flows of the basins (figure 5-1).

Step 2: Project Future Well Development

When calculating impacts from future wells, the rate of future well development must be estimated. This estimation is completed by projecting the linear trend of current high capacity well development within a study area over the previous ten years (1999-2008). The yearly estimated well development for the study area is equivalent to the slope of the trend line and takes into account known limitations, such as moratoriums, on well development.

Step 3: Incorporate Future Wells into the Study Area

The number of future wells estimated in Step 2 above must be incorporated into the study area. The future wells are located geographically within the study area by randomly placing each future well on a site where the soils have been defined by the U.S. Department of Agriculture as irrigable. To ensure that land was available for development, a 1,400-foot-radius circle (slightly larger than the radius of an average center pivot) was drawn around every existing well, and all lands already irrigated within the circles were removed from the inventory of irrigable lands that are available for development. In addition, all irrigable land areas of less than forty acres in size that are available for new development were excluded.

Step 4: Calculate the Lag Impacts of Future Wells

Depletions from future wells are calculated following the same methodology outlined in Section 4.2.3. The depletions of future wells are calculated independently of current well development. The twenty-five-year depletions from future well development are removed from the lag-adjusted flow record created in Step 6 of Section 4.2.3 to develop the future lag-adjusted flow record.

Step 5: Create a Historic Flow Record with Lag Impacts from Current and Future Well Development

The historic record, with the twenty-five-year lag impacts from all current wells created at the end of Step 6 in Section 4.2.3 subtracted (i.e., the lag-adjusted flow record), is used as the starting point in developing the future lag-adjusted flow record. The depletions from future wells incorporated into the study area are calculated for each year through the twenty-five-year period and subtracted from the lag-adjusted flow record.

The sum of the future depletions is subtracted from the lag-adjusted daily flow record for the period 1989-2008 to create a future adjusted flow record to account for all current well lag impacts and potential future well depletions. The future lag-adjusted flow record is then used to calculate the average number of days available for diversion to the most junior appropriator within the basin. This new future lag-adjusted flow record is compared to the number of days necessary for the most junior surface water appropriator to divert in the basin.

In those basins for which the appropriate geologic and hydrologic data were not available, the impacts of future well development were not calculated due to uncertainty of the degree of hydrologic connection. In many of those cases, the number of days in which surface water is available for diversion far exceeds the number of days necessary to meet the NCCIR, and the final conclusion would likely not change even with the addition of lag impacts.

4.3 Development of the 10/50 Areas

The 10/50 area is defined as the geographic area within which groundwater is hydrologically connected to surface water. A well constructed in the 10/50 area would deplete river flow by at least ten percent of the water pumped over a fifty-year period. The 10/50 areas are not dependent on the quantity of water pumped, but rather on each basin's geologic characteristics and the distance between each well and the stream.

4.3.1 Numerical and Analytical Models Used in Development of the 10/50 Areas

The Department reviewed available numerical models to assess their validity in defining the 10/50 area. The Upper Big Blue NRD developed a numerical MODFLOW groundwater model for the Blue Basins to define the 10/50 area and provided a model report to the Department in September 2008. The Department then requested the specific model datasets for review in Spring 2009. Subsequent to the Department's review, the Upper Big Blue NRD was informed that current shortcomings exist with the Blue Basin's numerical model.

Additionally, the Upper Big Blue NRD had previously provided results from an externally peer-reviewed model developed using Cooperative Hydrology Study (COHYST) data to delineate the extent of the hydrologically connected area to the Little Blue River. Upon further review by the

Department, the results of this model were not deemed to be technically sound at this time. The Department plans to work with the Upper Big Blue NRD to modify the model so that it may be appropriate for determining the 10/50 area in the Blue River Basins. In this evaluation the Department utilized the Hunt Method (Hunt,1999) to determine the 10/50 area in the Blue Basins.

In areas where an acceptable numerical model has not been developed but where appropriate geologic data exist, (Lower Niobrara Basin, portions of the Blue River Basins, and portions of the Missouri Tributary Basins) an analytical methodology was used to define the 10/50 area. The following steps were taken to calculate the extent of the 10/50 area:

1. Collect and prepare data (data will be provided by the Department upon request).
2. Evaluate available data to determine if the principal aquifer is present and if sufficient data exist to determine that a given stream reach is in hydrologic connection with the principal aquifer.
3. Complete calculations to delineate the 10/50 boundary for these basins.
4. Develop the 10/50 area.

In all other areas, where sufficient data do not exist or where the principal aquifer is not present, the 10/50 area could not be determined at this time.

Step 1: Data Preparation

The following data are necessary for determining the extent of the 10/50 area:

- Aquifer transmissivity
- Aquifer specific yield
- Locations of perennial streams
- Point grid of distances to streams
- Streambed conductance (to apply the Hunt Method, only available in the Blue Basins)

The aquifer properties used in the study were found in the report “Mapping of Aquifer Properties – Transmissivity and Specific Yield – for Selected River Basins in Central and Eastern Nebraska,” published by the Conservation and Survey Division (CSD, 2005).

The location and extent of perennial streams were found in the permanent streams GIS coverage available from the USGS National Hydrography Dataset. The main stems of each river and of their perennial tributaries were included in the calculations for individual basins.

A point grid with a spacing of one mile was developed to identify specific distances from the stream and to store those locations that were within the 10/50 area.

The streambed conductance data was utilized from a report provided by the Upper Big Blue Natural Resources District (Bitner, 2008)

Step 2: Identify Principal Aquifers and Hydrologic Connection to Perennial Streams

The extent of hydrologic connection between aquifers and streams was primarily determined from maps generated by the Conservation and Survey Division (CSD, 2005). Supporting evidence from other published reports may also be used in some cases to delineate the extent of hydrologic connection between aquifers and streams. This information is referenced where used.

Step 3: Perform Jenkins SDF Calculations

In the Lower Niobrara River Basin and the Bazile Creek subbasin of the Missouri River Tributary Basins, the Jenkins SDF method used. The Jenkins SDF method utilizes the following two terms, for which solutions are derived graphically using the curve shown in figure 4-4.

Depletion percentage term: v/Qt

Dimensionless term: $\frac{t}{sdf}$

Where v = volume of stream depletion during time t

Qt = net volume pumped during time t

t = time during the pumping period since pumping began

$sdf = \frac{a^2 * S}{T}$

where a = perpendicular distance between the well and stream

S = average specific yield of the aquifer between the well and the stream

T = average transmissivity of the aquifer between the well and the stream

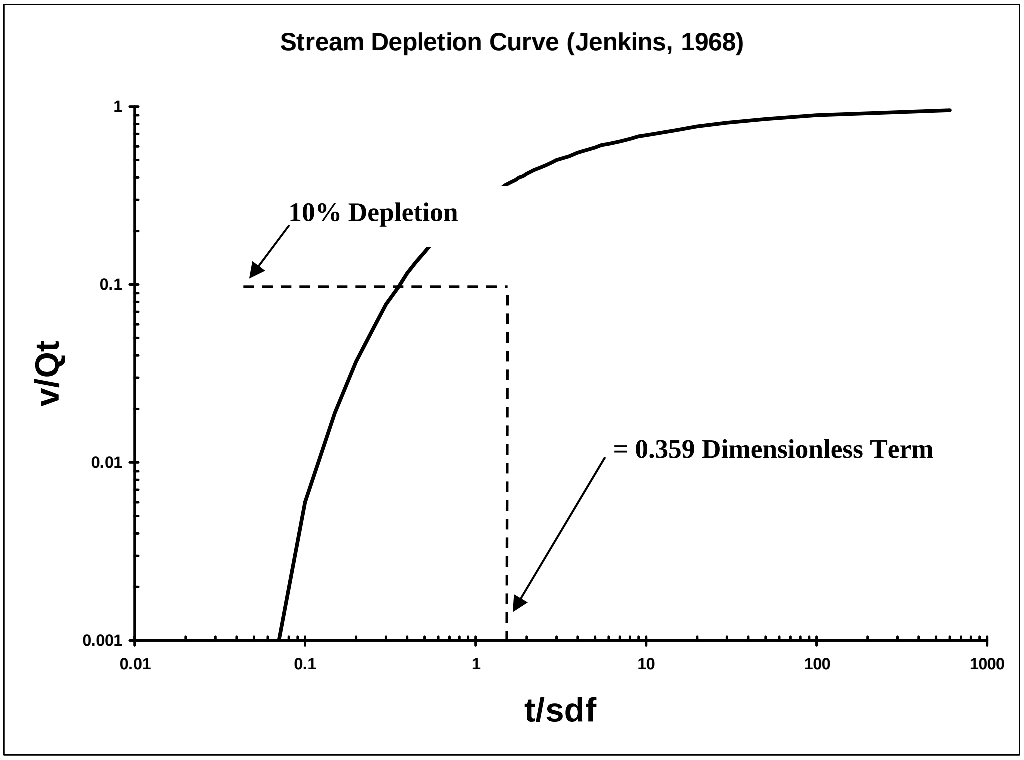

Figure 4-4. Stream depletion curve from Jenkins (1968). The dimensionless term will equal 0.359 when the depletion percentage is equal to ten percent. The aquifer properties (transmissivity and specific yield) at each grid point and the distance of each grid point from the nearest perennial stream will be utilized to calculate the dimensionless term.

Figure 4-5 illustrates an example of the data used in the determination of the dimensionless term at each point. The known values for the 10/50 calculation are as follows:

- t is 50 years, or 18,262 days
- T is the aquifer transmissivity
- S is the aquifer specific yield
- a is the perpendicular distance from the grid point to the nearest perennial stream

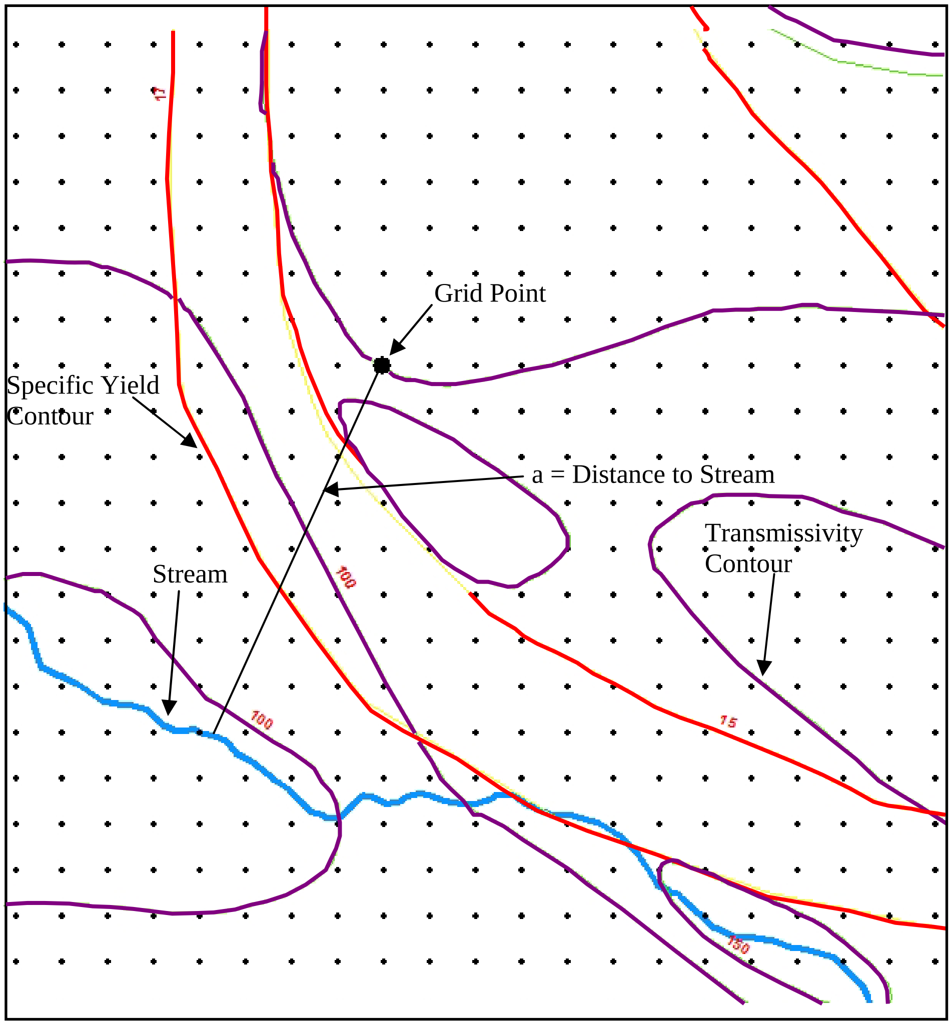

Figure 4-5. An example of the data and method used in determination of the 10/50 area. The purple and red lines are isolines (constant value along that line). Transmissivity and specific yield values for individual points are interpolated between the two nearest contour lines.

Step 4: Developing the 10/50 Area

Once the value for the dimensionless term is derived, those grid points with a dimensionless term value greater than 0.359 are included as part of the 10/50 area. All points that meet this requirement are merged to develop the complete 10/50 area for the basin.

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The total area of the Blue River surface water basins in Nebraska is approximately 7,100 square miles, of which 4,600 square miles are in the Big Blue River Basin and 2,500 square miles are in the Little Blue River Basin. NRDs with significant area in the basins are the Little Blue, the Lower Big Blue, the Upper Big Blue, and the Tri-Basin NRDs. The basins are the subject to an interstate compact between Kansas and Nebraska that sets state line target flows.

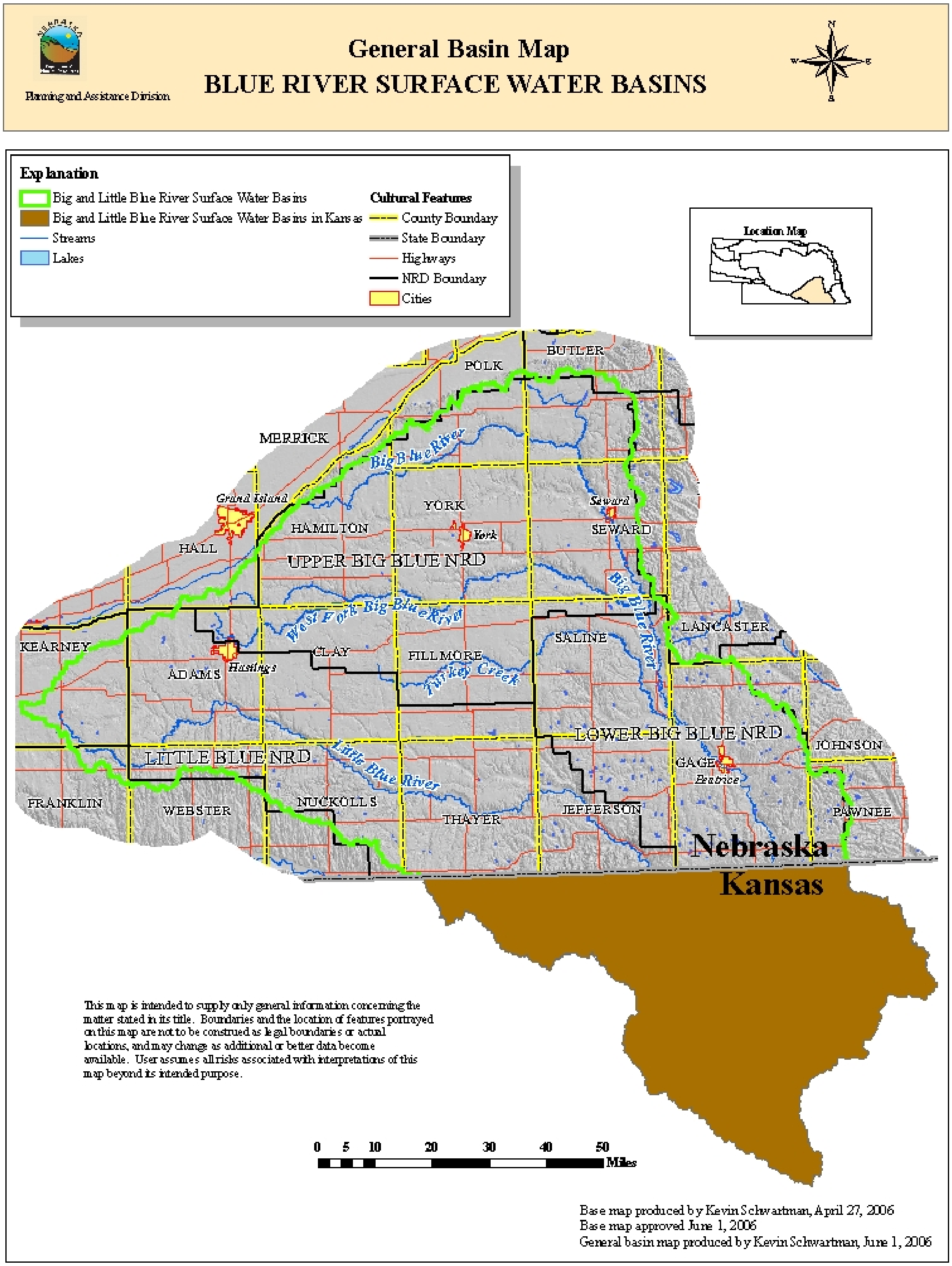

Figure 5-1. General basin map, Blue River Basins.

5.3 Nature and Extent of Water Use

5.3.1 Groundwater

Groundwater in the basins is used for a variety of purposes: domestic, industrial, livestock, irrigation, and other uses. A total of 25,430 groundwater wells had been registered within the basins as of December 31, 2008 (Department registered groundwater wells database) (figure 5-2). The locations of all active groundwater wells are shown in figure 5-3.

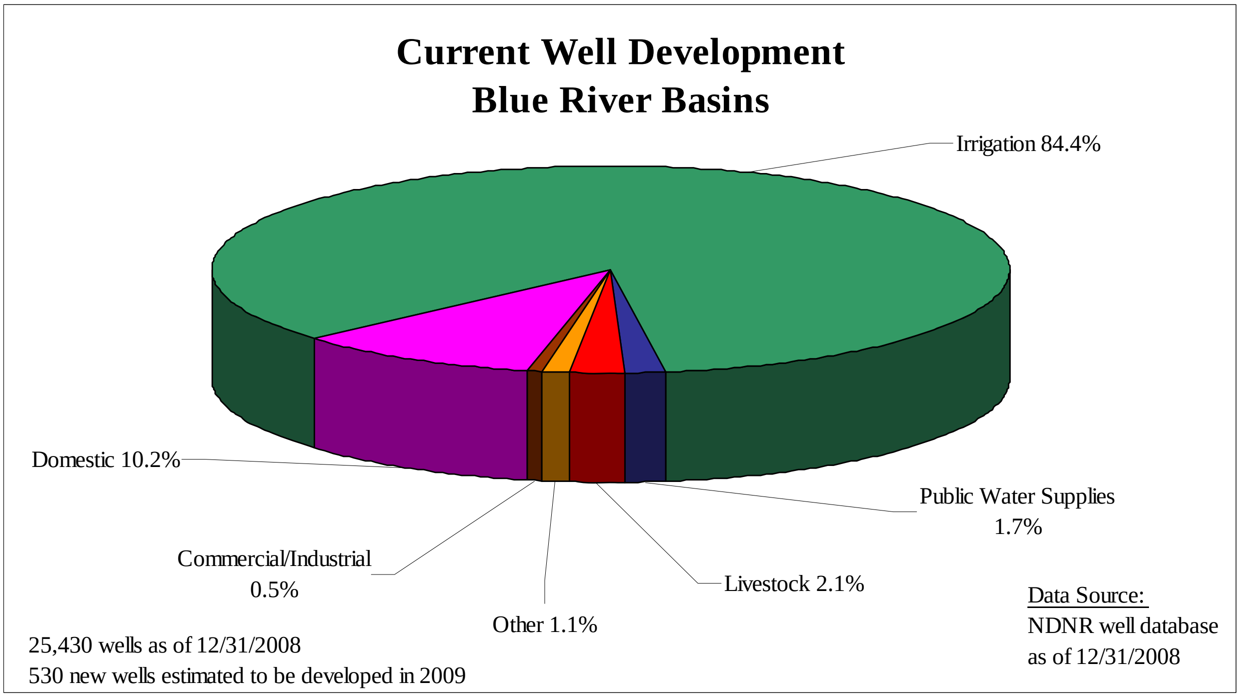

Figure 5-2. Current well development by number of registered wells, Blue River Basins.

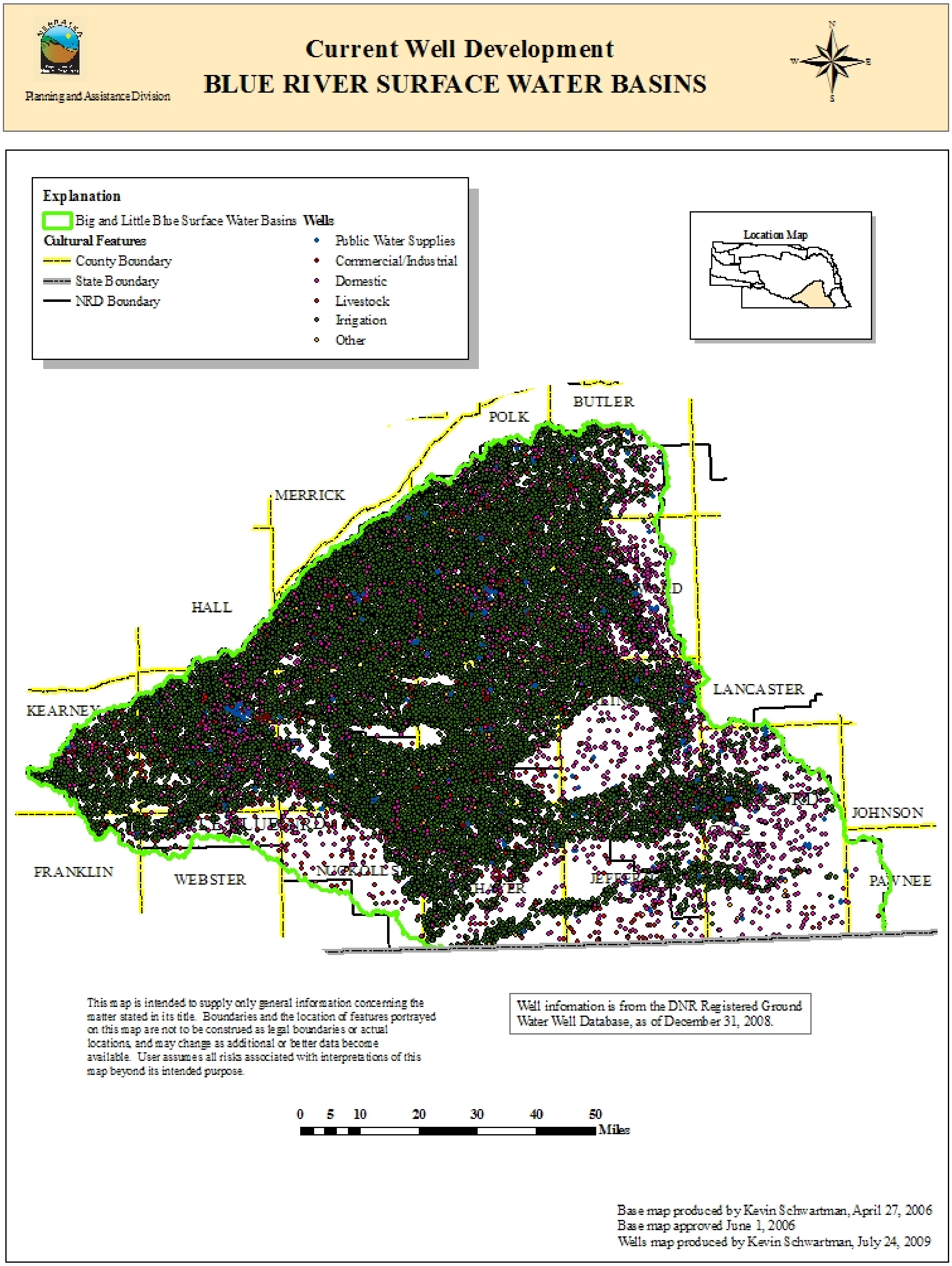

Figure 5-3. Current well locations, Blue River Basins.

5.3.2 Surface Water

As of December 31, 2008, 2,304 active surface water appropriations were held in the basins, issued for a variety of uses (figure 5-4). Most of the surface water appropriations are irrigation and storage uses that tend to be located on the major streams. The first surface water appropriations in the basins were permitted in 1868, and development has continued through the present day. The approximate locations of the surface water diversion points are shown in figure 5-5.

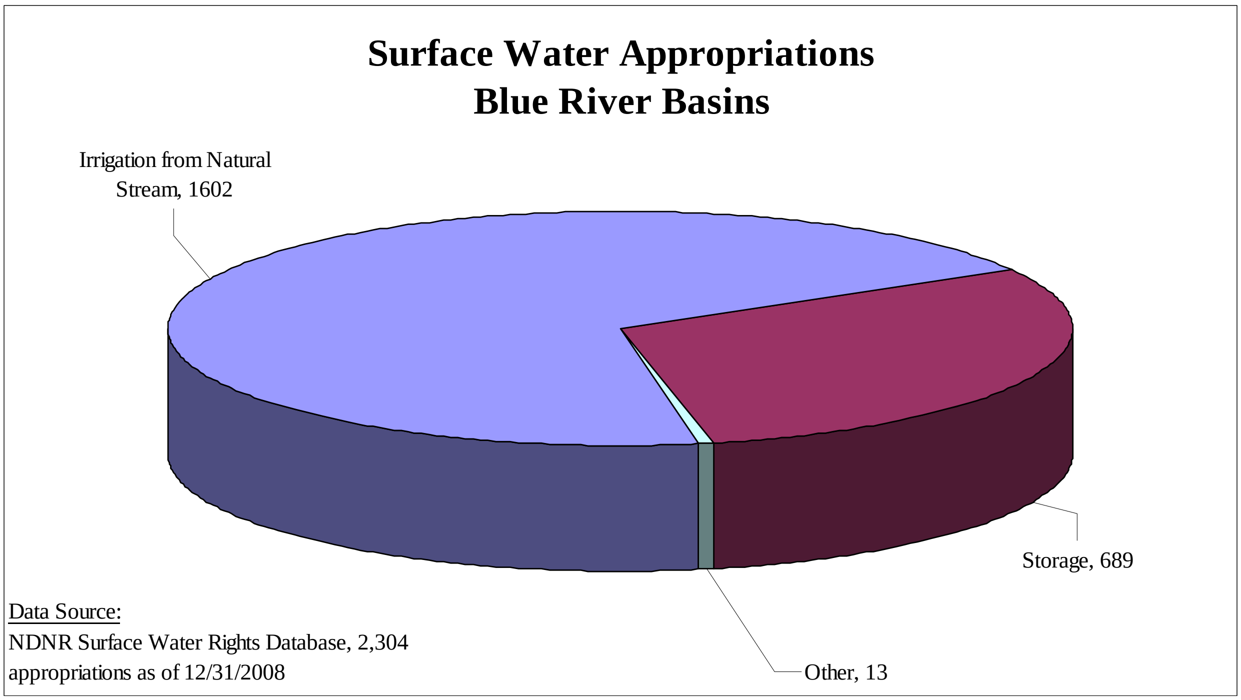

Figure 5-4. Surface water appropriations by number of diversion points, Blue River Basins.

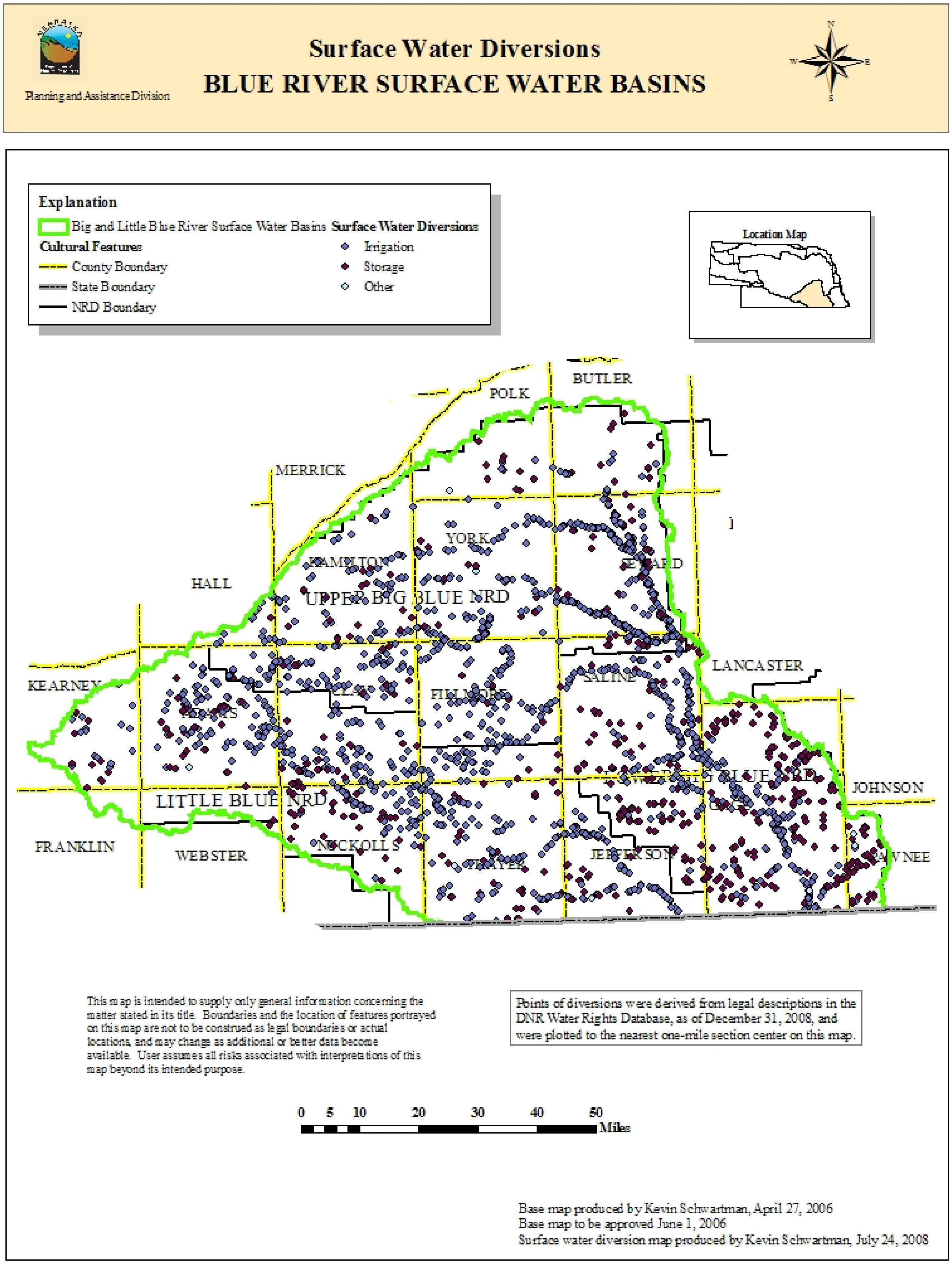

Figure 5-5. Surface water appropriation diversion locations, Blue River Basins.

5.4 Hydrologically Connected Area

The Blue River Basins can be divided into two distinct areas based on the presence or absence of glacial deposits. At the present time, the Department only has sufficient data to determine the 10/50 area for the Big Blue River and Little Blue River Basins in the western (non-glaciated) portion of the basins. While a numeric groundwater model has been developed for the area and the results were previously utilized by the Department, recent reviews by the Department have deemed this model inappropriate for use at this time. Therefore, the 10/50 area was determined using the Hunt methodology (Hunt, 1999). Figure 5-6 specifies the extent of the 10/50 area for the western portion of the basin.

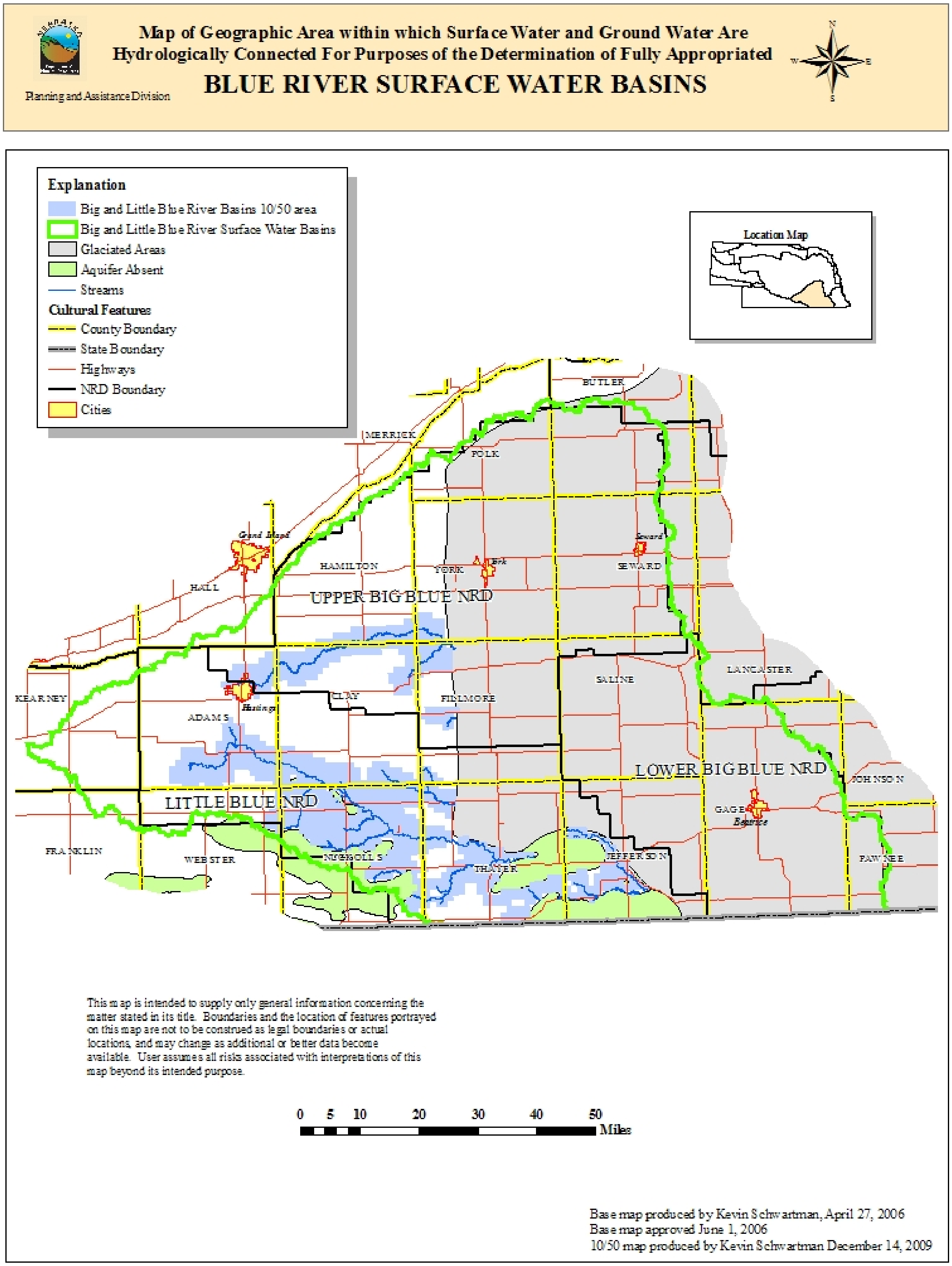

Figure 5-6. 10/50 area for the Blue River Basins.

5.5 Net Corn Crop Irrigation Requirement

Figure 5-7 is a map of the net corn crop irrigation requirement (NCCIR) for the Blue River Basins (DNR, 2005). The greatest NCCIR of a junior surface water appropriation in the Big Blue River Basin is 9.0 inches, and the greatest NCCIR in the Little Blue River Basin is 9.7 inches. To assess the number of days required for diversion, a surface water diversion rate equal to 1 cfs per 70 acres, a downtime of ten percent, and an irrigation efficiency of 80% were assumed. Based on these assumptions, the junior surface water appropriation in the Big Blue River Basin would need 23.9 days annually to divert 65% of the NCCIR and 31.3 days to divert 85% of the NCCIR. The junior surface water appropriation in the Little Blue River Basin will need 25.8 days annually to divert 65% of the NCCIR and 33.7 days to divert 85% of the NCCIR.

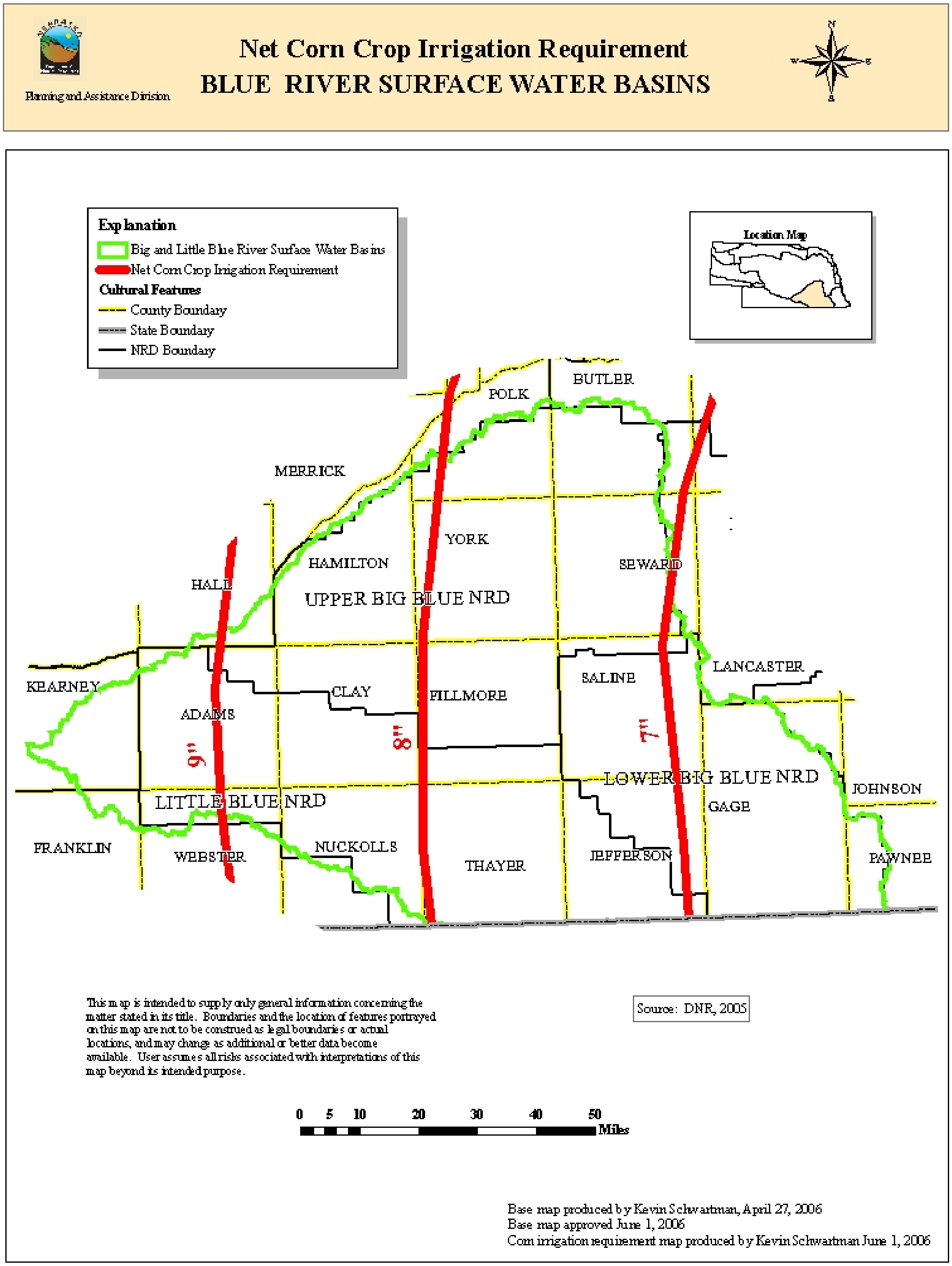

Figure 5-7. Net corn crop irrigation requirement, Blue River Basins.

5.6 Surface Water Closing Records

Tables 5-1 and 5-2 record all surface water administration that has occurred in the basins between 1989 and 2008.

Table 5-1. Surface water administration in the Big Blue River Basin, 1989-2008.

Year	Water Body	Days	Closing Date	Opening Date
2000	Turkey Creek	3	Jun 9	Jun 12
2000	Big Blue River above Lincoln Creek	2	Aug 15	Aug 17
2001	Big Blue River above Lincoln Creek	1	Aug 14	Aug 15
2002	Big Blue River above Lincoln Creek	11	Jul 11	Jul 22
2002	Big Blue River above Lincoln Creek	14	Jul 30	Aug 13
2002	Big Blue River Basin	8	Aug 5	Aug 13
2002	North Fork Big Blue River	1	Aug 14	Aug 15
2003	Big Blue River above Lincoln Creek	49	Jul 16	Sep 3
2003	Big Blue River Basin	11	Jul 17	Jul 28
2003	Big Blue River Basin	8	Aug 11	Aug 19
2004	Big Blue River above Lincoln Creek	16	Aug 3	Aug 19
2005	Big Blue River above Lincoln Creek	14	Jul 12	Jul 26
2005	Big Blue River Basin	13	Jul 13	Jul 26
2005	Big Blue River above West Fork	8	Jul 18	Jul 26
2005	Big Blue River above Lincoln Creek	11	Aug 4	Aug 15
2005	Big Blue River Basin	6	Aug 9	Aug 15
2005	Big Blue River above West Fork	5	Aug 10	Aug 15
2006	Big Blue River above West Fork	13	Jul 1	Jul 14
2006	Big Blue River above West Fork	22	Jul 17	Aug 8
2006	Big Blue River Basin	11	Jul 3	Jul 14
2006	Big Blue River Basin	5	Jul 19	Jul 24
2006	Big Blue River Basin	9	Jul 29	Aug 7

Table 5-2. Surface water administration in the Little Blue River Basin, 1989-2008.

Year	Water Body	Days	Closing Date	Opening Date
1989	Rose Creek	4		
1991	Little Blue River Basin	45	Aug 16	Sep 30
1991	Rose Creek	94	Jun 28	Sep 30
2002	Little Blue River Basin	11	Jul 18	Jul 29
2002	Little Blue River Basin	13	Aug 6	Aug 19
2002	Little Blue River Basin	7	Sep 9	Sep 16
2004	Little Blue River Basin	10	Sep 13	Sep 23
2005	Little Blue River Basin	15	Jul 11	Jul 26
2005	Little Blue River Basin	7	Aug 8	Aug 15
2006	Little Blue River Basin	9	Jul 5	Jul 14
2006	Little Blue River Basin	1	Jul 20	Jul 21
2006	Little Blue River Basin	7	Jul 31	Aug 7
2006	Little Blue River Basin	8	Aug 9	Aug 17

5.7 Evaluation of Current Development

5.7.1 Current Water Supply

The current water supply is estimated by using the previous twenty years (1989-2008) of surface water administration. The results of the analyses conducted for the Big Blue River Basin and Little Blue River Basin, respectively, are shown in tables 5-3 and 5-4. The results indicate that the current surface water supply in the Big Blue River Basin provides an average of at least 54.5 days available for diversion between July 1 and August 31 and 145.3 days available for diversion between May 1 and September 30 (table 5-5). The results indicate that the current surface water supply in the Little Blue River Basin provides an average of at least 55.4 days available for diversion between July 1 and August 31 and 143.7 days available for diversion between May 1 and September 30 (table 5-6).

Table 5-3. Estimate of the current number of days surface water is available for diversion in the Big Blue River Basin.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1989	62	153
1990	62	153
1991	62	153
1992	62	153
1993	62	153
1994	62	153
1995	62	153
1996	62	153
1997	62	153
1998	62	153
1999	62	153
2000	60	151
2001	61	152
2002	36	127
2003	16	104
2004	46	137
2005	37	128
2006	27	118
2007	62	153
2008	62	153
Average	54.5	145.3

Table 5-4. Estimate of the current number of days surface water is available for diversion in the Little Blue River Basin.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1989	62	149
1990	62	153
1991	0	59
1992	62	153
1993	62	153
1994	62	153
1995	62	153
1996	62	153
1997	62	153
1998	62	153
1999	62	153
2000	62	153
2001	62	153
2002	38	122
2003	62	153
2004	62	143
2005	40	131
2006	37	128
2007	62	153
2008	62	153
Average	55.4	143.7

Table 5-5. Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is currently available for diversion in the Big Blue River Basin.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	Average Number of Days Available for Diversion with Current Development
July 1 – August 31 (65% Requirement)	23.9	54.5 (30.6 days above the requirement)
May 1 – September 30 (85% Requirement)	31.3	145.3 (114.0 days above the requirement)

Table 5-6. Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is currently available for diversion in the Little Blue River Basin.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	Average Number of Days Available for Diversion with Current Development
July 1 – August 31 (65% Requirement)	25.7	55.4 or greater (at least 29.6 days above the requirement)
May 1 – September 30 (85% Requirement)	33.6	143.7 (110.0 days above the requirement)

5.7.2 Long-Term Water Supply

In order to complete the long-term evaluation of surface water supplies, a future twenty-year water supply for the basins must be estimated. The basins' water sources are precipitation, which runs off as direct streamflow and infiltrates into the ground to discharge as baseflow, and groundwater movement into the basins, which discharges as baseflow. Using methodology published in the *Journal of Hydrology* (Wen and Chen, 2005), a nonparametric Mann-Kendall trend test of the weighted average precipitation in the basins was completed. The analysis showed no statistically significant trend in precipitation (P > 0.95) over the past fifty years (figure 5-8). Data do not exist to test whether trends in groundwater movement into the basin have changed. Therefore, using the previous twenty years of streamflow data as the best estimate of the future surface water supply is reasonable.

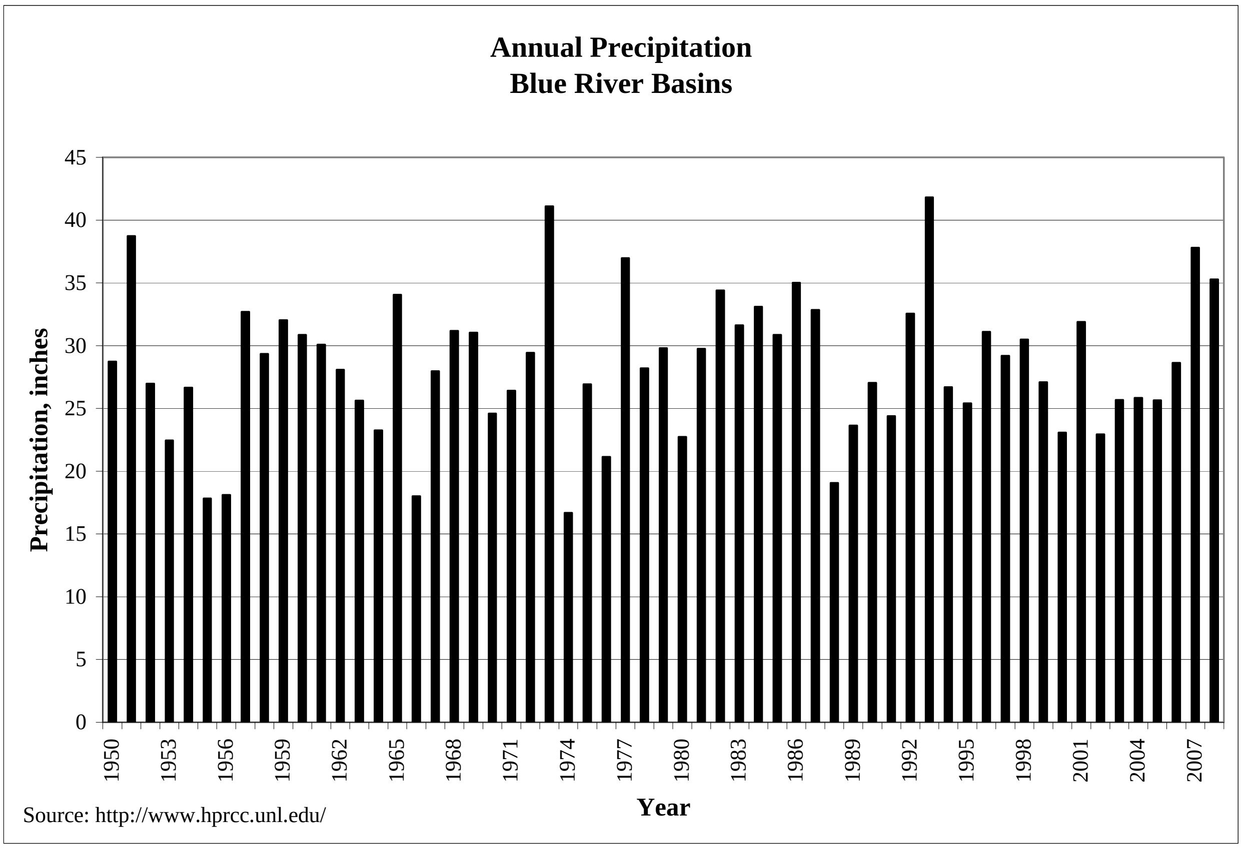

Figure 5-8. Annual precipitation, Blue River Basins.

5.7.3 Depletions Analysis

The future depletions due to current well development that could be expected to affect streamflow were estimated for the western portions of the Big Blue and Little Blue River Basins using Hunt methodology. The results estimate the future streamflow in the Big Blue River Basin to be depleted by 26 cfs in twenty-five years and flows in the Little Blue River Basin to be depleted by 26 cfs in twenty-five years.

5.7.4 Evaluation of Current Levels of Development against Future Water Supplies

The estimates of the twenty-year average number of days available for diversion are calculated by comparing the depleted future water supply with the flows necessary to satisfy the state line compact target flows. The results of the analyses are shown in tables 5-7 and 5-8. The results of the analyses as compared to the numbers of days surface water is required to be available to divert 65% and 85% of the NCCIR are detailed in tables 5-9 and 5-10. In all cases, the long-term surface water supply estimate, given current levels of development, is sufficient to meet the needs of the surface water irrigation users.

Table 5-7. Estimate of days surface water is available for diversion in the Big Blue River Basin with current development and twenty-five-year lag impacts.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1	60	151
2	62	153
3	58	137
4	62	153
5	62	153
6	62	153
7	62	153
8	62	153
9	62	153
10	62	153
11	62	153
12	56	147
13	61	152
14	22	113
15	0	87
16	43	134
17	26	114
18	24	115
19	61	152
20	62	153
Average	51.5	141.6

Table 5-8. Estimate of days surface water is available for diversion in the Little Blue River Basin with current development and twenty-five year lag impacts.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1	62	149
2	62	148
3	0	47
4	60	151
5	62	153
6	62	153
7	62	153
8	62	153
9	62	153
10	62	153
11	62	153
12	57	132
13	61	152
14	23	99
15	58	142
16	54	122
17	36	118
18	28	117
19	62	153
20	62	153
Average	53.0	137.7

Table 5-9. Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is available for diversion in the Big Blue River Basin with current development and lag impacts.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	**Average Number of Days Available for Diversion at Current Development with 25 Years of Lag Impacts**
July 1 – August 31 (65% Requirement)	23.9	51.5 (27.6 days above the requirement)
May 1 – September 30 (85% Requirement)	31.3	141.6 (110.3 days above the requirement)

Table 5-10. Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is available for diversion in the Little Blue River Basin with current development and lag impacts.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	**Average Number of Days Available for Diversion at Current Development with 25 Years of Lag Impacts**
July 1 – August 31 (65% Requirement)	25.7	53.0 (27.3 days above the requirement)
May 1 – September 30 (85% Requirement)	33.6	137.7 (104.1 days above the requirement)

5.8 Evaluation of Predicted Future Development

Estimates of the number of high-capacity wells (wells pumping greater than 50 gpm) that would be completed over the next twenty-five years, if no new legal constraints on the construction of such wells were imposed, were calculated based on extrapolating the present-day rate of increase in well development into the future (figure 5-9). The present-day rate of development is based on the linear trend of the previous ten years of development in the basins. Based on the analysis of the past ten years of development, the rate of increase in high-capacity wells is estimated to be 232 wells per year in the basin.

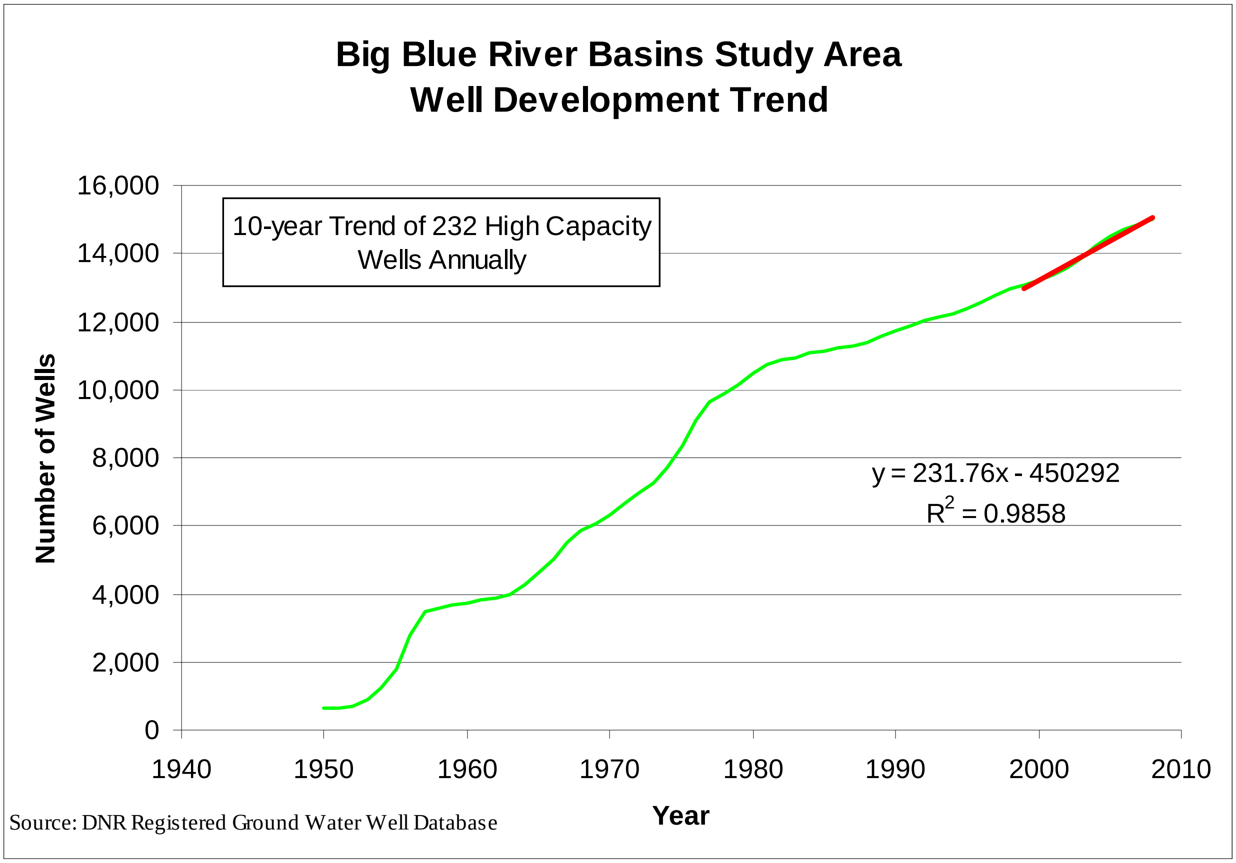

Figure 5-9. High capacity well development, western portion of Blue River Basins.

The future depletions due to current and future well development that could be expected to affect streamflow in the basin were estimated using SDF methodology. The results estimate the streamflow in the Big Blue River Basin will be depleted by an additional 1 cfs in ten years, 1cfs in fifteen years, 2 cfs in twenty years, and 4 cfs in twenty-five years due to potential future development. The results estimate the future streamflow in the Little Blue River Basin will be depleted by 2 cfs in ten years, 4 cfs in fifteen years, 6 cfs in twenty years, and 9 cfs in twenty-five years due to potential future development.

The estimate of the twenty-year average number of days surface water is available for diversion with additional future development is calculated by comparing the future lag-adjusted flow with the flows necessary to satisfy the state line compact flow targets. The results of the analyses are shown in tables 5-11 and 5-12. The results of the analyses as compared to the numbers of days surface water is required to be available to divert 65% and 85% of the NCCIR are detailed in tables 5-13 and 5-14. The results indicate that, based on current information, the Department's conclusion that the basin is not fully appropriated would not change if no additional constraints are placed on future development of surface water and groundwater in the basin.

Table 5-11. Estimated number of days surface water is available for diversion in the Big Blue River Basin with current and predicted future development.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1	60	151
2	62	153
3	58	137
4	62	153
5	62	153
6	62	153
7	62	153
8	62	153
9	62	153
10	62	153
11	62	153
12	56	147
13	61	152
14	22	113
15	0	87
16	43	134
17	26	114
18	24	115
19	61	152
20	62	153
Average	51.5	141.6

Table 5-12. Estimated number of days surface water is available for diversion in the Little Blue River Basin with current and predicted future development.

Year	July 1 though August 31 Number of Days Surface Water is Available for Diversion	May 1 through September 30 Number of Days Surface Water is Available for Diversion
1	62	149
2	62	148
3	0	47
4	60	151
5	62	153
6	62	153
7	62	153
8	62	153
9	62	153
10	62	153
11	62	153
12	57	132
13	61	152
14	23	99
15	58	142
16	54	122
17	36	118
18	28	117
19	62	153
20	62	153
Average	53.0	137.7

Table 5-13. Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is available for diversion in the Big Blue River Basin with current and predicted future development.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	Average Number of Days Available for Diversion with Future Development and 25 Years of Lag Impacts
July 1 – August 31 (65% Requirement)	23.9	51.5 (27.6 days above the requirement)
May 1 – September 30 (85% Requirement)	31.3	141.6 (110.3 days above the requirement)

Table 5-14. Comparison between the number of days required to meet the net corn crop irrigation requirement and number of days surface water is available for diversion in the Little Blue River Basin with current and predicted future development.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	Average Number of Days Available for Diversion with Future Development and 25 Years of Lag Impacts
July 1 – August 31 (65% Requirement)	25.7	53.0 (27.3 days above the requirement)
May 1 – September 30 (85% Requirement)	33.6	137.7 (104.1 days above the requirement)

5.9 Sufficiency to Avoid Noncompliance

The State of Nebraska is a signatory member of the Kansas – Nebraska Big Blue River Compact (Compact). The purposes of the Compact are to promote interstate comity, to achieve an equitable apportionment of the waters of the Big Blue River Basin, to encourage continuation of the active pollution-abatement programs in each of the two states, and to seek further reduction in pollution of the waters of the Big Blue River Basin.

The Compact sets state line flow targets from May 1 through September 30. The state line targets, measured in cubic feet of water per second, are shown in table 5-15. If the flow targets are not met, then the State of Nebraska is required to take the following actions:

1. Limit surface water diversions by natural flow appropriators to their decreed appropriations;
2. Close natural flow appropriators with priority dates junior to November 1, 1968, in accordance with the doctrine of priority;
3. Ensure that no illegal surface water diversions are taking place; and
4. Regulate wells installed after November 1, 1968, within the alluvium and valley side terrace deposits downstream of Turkey Creek in the Big Blue River Basin and downstream of Walnut Creek in the Little Blue River Basin, unless the Compact Administration determines that such regulation would not yield any measurable increase in flows at the state line gage.

For the present time, the Compact Administration has found that the regulation of those wells will not yield measurable increases in flow at the state line.

Table 5-15. State line flow targets for the Blue River Basins.

Month	Big Blue River Target Flow	Little Blue River Target Flow
May	45 cfs	45 cfs
June	45 cfs	45 cfs
July	80 cfs	75 cfs
August	90 cfs	80 cfs
September	65 cfs	60 cfs

As long as Nebraska administers surface and groundwater in compliance with the Compact, decreased streamflow, in and of itself, will not cause Nebraska to be in noncompliance; therefore, any depletion would not cause Nebraska to be in noncompliance. Decreased streamflows could, however, increase the number of times the state would have to administer water to remain in compliance, thereby reducing the number of days available for junior irrigators to divert.

5.10 Groundwater Recharge Sufficiency

The streamflow is sufficient to sustain over the long term the beneficial uses from wells constructed in aquifers dependent on recharge from the stream, as explained in Appendix G.

5.11 Current Studies being Conducted to Assist with Future Analysis

A groundwater model developed for the Big Blue and Little Blue River Basins was reviewed by the Department in Spring 2009. The Department met with the Upper Big Blue NRD to inform them that shortcomings currently exist with the model. The model is currently being redeveloped for resubmission to the Department at which time it will be determined if it is appropriate for determining the extent of the 10/50 area for the Big Blue and Little Blue Basins. Future efforts may be made to refine this model to estimate lag impacts from wells within the basins.

5.12 Relevant Data Provided by Interested Parties

The Department published a request for relevant data from interested parties for this year's evaluation on August 19, 2009 (see Appendix B for affidavit). The Department did not receive any such information.

5.13 Conclusions

Based on the analysis of the sufficiency of the long-term surface water supply in the Blue River Basins, the Department has reached a preliminary conclusion that the basins are not fully appropriated. The Department has also determined that, if no additional legal constraints are imposed on future development of hydrologically connected surface water and groundwater and reasonable projections are made about the extent and location of future development, this preliminary conclusion would not change to a conclusion that the basin is fully appropriated, based on current information.

The analysis of lag effects of current development for areas in the western portion of the Big Blue River Basin indicates a reduction in streamflows of 26 cfs in twenty-five years. The analysis of lag effects of current development for areas in the western portion of the Little Blue River Basin indicates a reduction in streamflows of 26 cfs in twenty-five years. It was not possible to calculate the lag effects of current development for areas in the eastern portions of the basins at this time due to the glaciated nature of the area and the fact that the principal aquifer is absent or very thin (CSD, 2005).

The analysis of the impacts of potential future development in the western portion of the Big Blue River Basin based on current development trends indicates an additional reduction in streamflows of 4 cfs in twenty-five years. The analysis of the impacts of potential future development in the western portion of the Little Blue River Basin based on current development trends indicates an additional reduction in streamflows of 9 cfs in twenty-five years. The potential impacts of future development in the eastern portions of the basins were not evaluated at this time due to the glaciated nature of the area and the fact that the principal aquifer is absent or very thin (CSD, 2005).

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