Little Blue Natural Resources District
Spring 2016 Water Levels

The Township Map "A" for 2016 Spring Static Water Levels shows the average change across the entire District to be -0.08 of a foot. Eight one hundredths of a foot is so small it is called "no change" as an average from last spring. But there was not a lot of improvement this spring as to where levels stand, more on that later. Another way to look at the 2016 spring levels compared to 2015 is map "AA". Each monitored site is color coded by a point as to the change in the water table, the legend will provide a range of values in decimal feet. The final map in this series is "AAA" and is a 1975 to 2016 change map. Again it uses colored points to quantify the change, but the legend is to a different scale. The sites noted by black were measured in 1975 but for some reason; the well was capped, the wellhead replaced with one without access, or the well abandoned, it was removed from the monitoring network.

The reason it was stated above that there is not a lot of improvement as to where levels stand is because of the Spring Water Levels sheet "B". That map and associated table shows that 123 sites were above their lowest level of record while 216 were still below that point; noted as below action level, below 50% Reasonable Acceptable Decline (RAD), or below 100% RAD. 4 were below the level where allocation would begin (100% RAD), they are all in Unit 8. But 80% of the wells in any area have to be below the 100% RAD for three years before any allocation is set, see page 14 of the District's Rules and Regulations for more discussion on that topic. An explanation of Action Level and RAD can be found at the bottom of sheet "B".

What does show up on Township Map "A" is the difference from the average for Units 1, 2, 3, and 8; they are all lower. Units 4, 5, 6, and 7 in the eastern half of the District are higher. No Unit appears to be "average".

So if we look at the rainfall map "C" 36 reporting stations in the Little Blue NRD had an average annual precipitation of 30.52 inches. These annual precipitation rates range across the District the same in the same manner the water levels did. Roseland, Juniata, and Bladen in the west recorded 27.5, 25.5, and 23.3 annual inches respectively; Bruning, Hebron, and Chester had 35.6, 35.1, and 35.3. The 2015 Pumping Info sheet "D" appears tied to those rainfall amounts. For example; the average irrigation application in township 5N-12W was 9.0 inches and the annual precipitation was only 23 to 27 inches. Annual rainfall in 4N-1E was 43 inches and they only applied 6.1 inches of irrigation water. Anomalies do show up; townships around Chester had over 30 inches of rain, only applied around 6 inches of irrigation, but the townships still declined. The same is true for township 2N-3E east of Fairbury. And 7N-8W really stands out with an average of 12.2 inches of irrigation. If you are an irrigator please use this map to compare how much water you used to others in your township, in the future efficiency in use is what the District will be talking about.

The Static Water Level & Rainfall graph "E" shows how water levels, rainfall, and withdrawals are relative to each other. If there is an abundance of annual rainfall, water levels rise, if

precipitation is short for the year, water levels decline. The instant result of annual rainfall is more or less demand on the aquifer for irrigation, re-charge to the aquifer from precipitation takes longer and is less obvious on the change maps. Nature provides the annual rainfall but what the District really wants to stress with information collected from irrigation flow meters is efficiency in use. How much water is withdrawn from the aquifer is what can be managed to lessen annual changes in the water table.

The District calculates the average change from spring to spring in all the wells that are measured, the cumulative change is charted on 4 graphs "F". One graph is District wide, the change in water level for every well measured. The cumulative decline is about 6.75 feet. However; the District is actually three different geologic areas, identified as separate aquifers in a report completed for the District by the hydro-geologic consulting firm Leggette, Brashears & Graham (LBG). Geologic Area 1 is a large sand & gravel aquifer stretching from Adams to Thayer county and catching a small portion of northeast Jefferson. The average change in the wells measured in that area is a decline of -7.25 feet. Geologic Area 2 is a buried paleo-valley sand & gravel aquifer that stretches from a point in Kansas to the southwest of Chester to a point in the Lower Big Blue NRD east of Fairbury. The average change in the water table in that area is -6.0 feet. Finally, Geologic Area 3 is an aquifer older than the sand & gravel units; it is comprised of limestone, sandstone, shales, and clays. It underlies the towns of Nelson, Gilead, Gladstone, and Reynolds had has very little high capacity well development. Some of those formations have difficulty even producing enough water for a domestic well. The average change in the wells measured in that area is a rise of +5.5 feet.

The final chart marked "F" is headed Units 1/3. Other articles have spoken about the area and on this spring's township maps this will probably stand out to some. It was noted in 2004 that levels in those 5 townships were fluctuating to a larger degree than the rest of the District. It can be noted that the average change of the wells monitored in the area as compared to the District graph have fallen more from 2000 to 2008, but have also risen a bit more from 2008 to 2012. This last downturn to the spring of 2016 has also occurred at a steeper rate.

The static water level from the various wells that are measured is compared with yet another method in the final chart, Static Water Level by Risk Area "G". The LBG report separated the 3 Geologic Areas into 6 different Risk Areas. Geologic Area 3's sandstone, limestone, and shale aquifers were called the Principal Aquifer < Than 10 Feet Thick, and the Sand & Gravel Aquifers of Geologic Areas 1 & 2 were broken into Very High, High, Moderate, Low, and Very Low risk areas. There are 5 graphs on the chart "G" which represents the change in the water level in the various areas, the low and very low risk areas are graphed together. Each replicate one another with the same ups and downs, and also compares to the blue rainfall graph from the Static Water Level Change & Rainfall graph "E". The difference in water levels in 2016 between each area reflect the difference in annual groundwater withdrawals, the total amounts which are affected by the varying aquifer quality and capabilities.

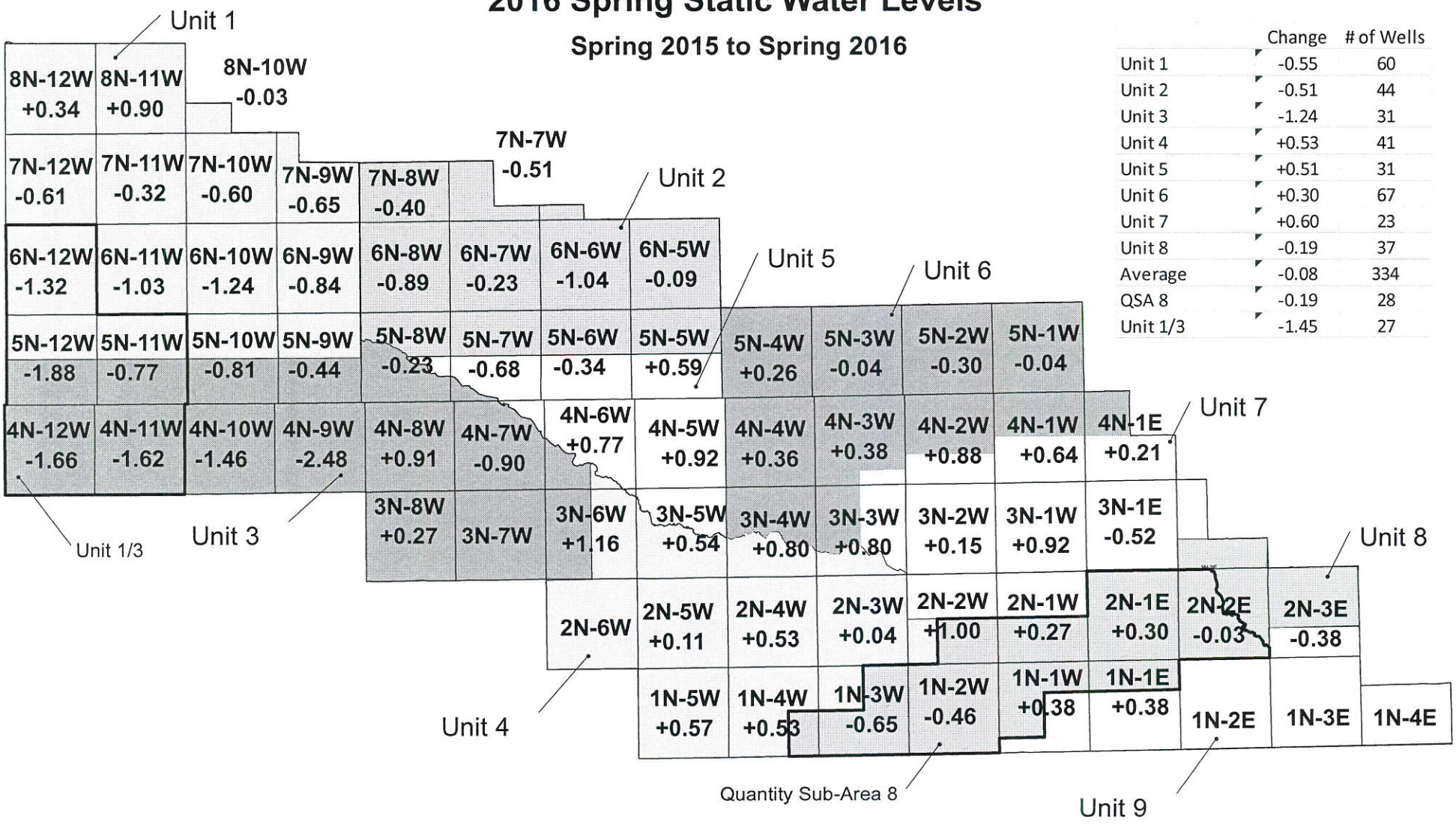
There is one final map, Permits per Risk Area 'H", with the 967 wells installed since 2009 located as black points over the 6 Risk Areas of the District. The district began ranking permits

and locating them per Risk Area in 2012. The map's legends lists the 513 wells permitted since 2012 with numbers and % of total wells per Risk Area. There is also a legend with the land acres and % of total located in each Risk Area. These legends indicate 1.6% of the wells have been installed in 28.1% of the land mass located in the Principal Aquifer < 10 Feet Thick, 10.9% of the wells have been installed in 13.7% of the land mass in the Very High Risk Area, and so on.

The District is requiring flow meters on all irrigation wells, and annual reporting on withdrawals from them and all high capacity wells; any high capacity well's use which includes but is not limited to irrigation, municipal, industrial, livestock, recreational, and wildlife. Meters are to be installed on a graduated basis, the final date when all meters are to be installed is March 31, 2017. Hopefully everyone affected by this regulation is aware of it and is acting to be in compliance by the date required for their location. Efficiency in use is the word, and quantifying everyone's annual withdrawals for their high capacity wells will allow each to know where they stand.

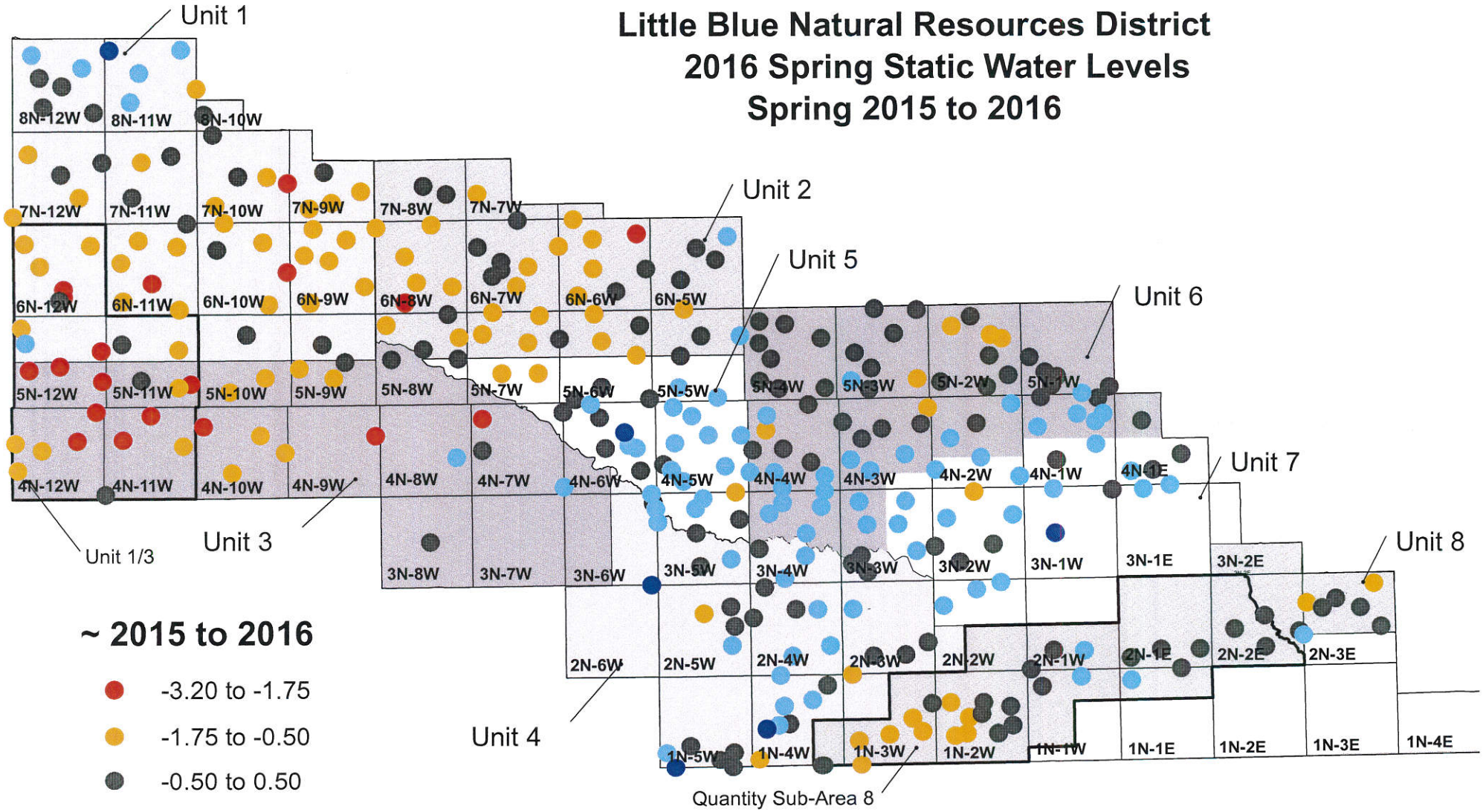
A

Little Blue Natural Resources District
2016 Spring Static Water Levels
Spring 2015 to Spring 2016

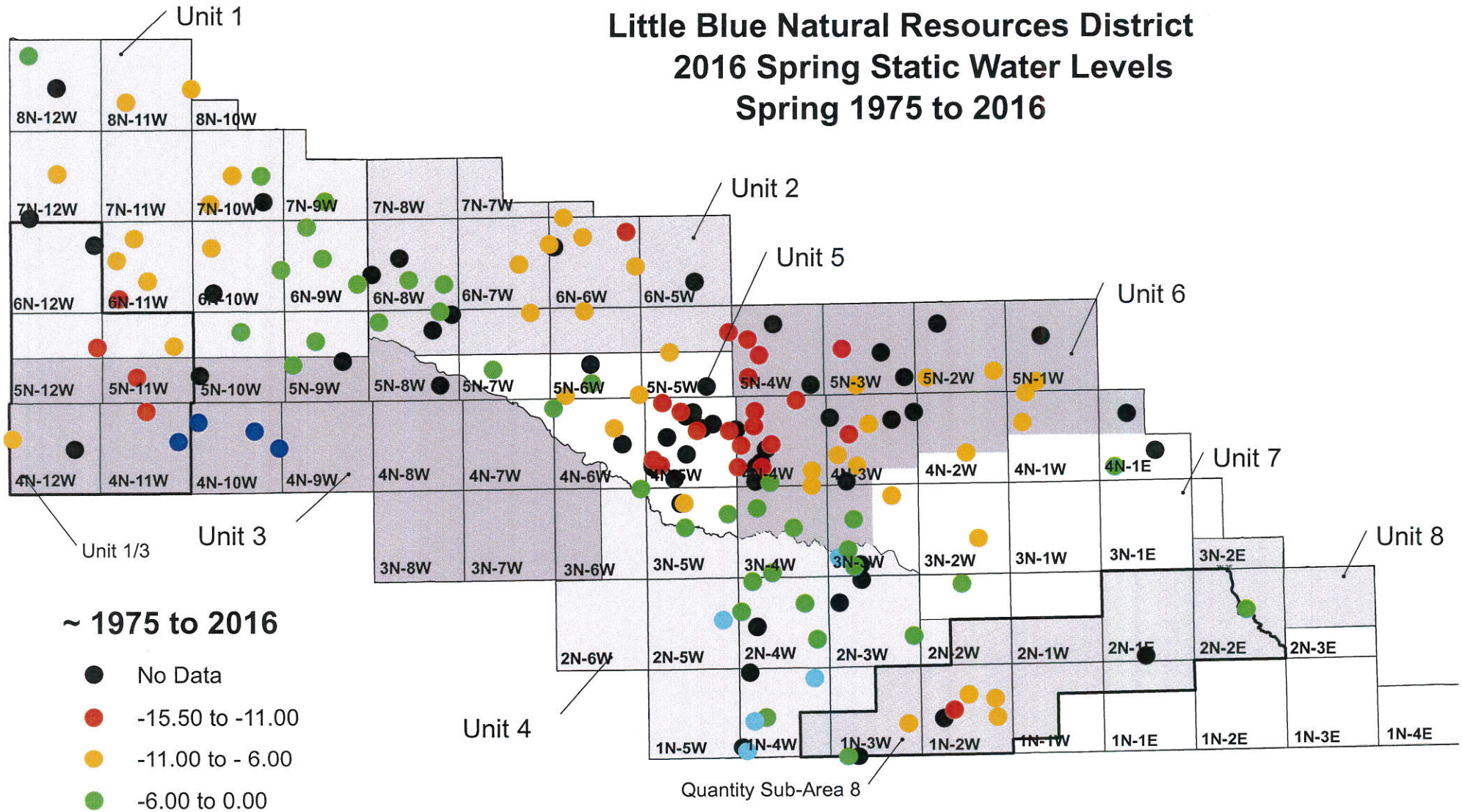


	Change	# of Wells
Unit 1	-0.55	60
Unit 2	-0.51	44
Unit 3	-1.24	31
Unit 4	+0.53	41
Unit 5	+0.51	31
Unit 6	+0.30	67
Unit 7	+0.60	23
Unit 8	-0.19	37
Average	-0.08	334
QSA 8	-0.19	28
Unit 1/3	-1.45	27

AA


Little Blue Natural Resources District
2016 Spring Static Water Levels
Spring 2015 to 2016
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Unit 6
Unit 7
Unit 8
Unit 1/3
Quantity Sub-Area 8
8N-12W
8N-11W
8N-10W
7N-12W
7N-11W
7N-10W
7N-9W
7N-8W
7N-7W
6N-12W
6N-11W
6N-10W
6N-9W
6N-8W
6N-7W
6N-6W
6N-5W
5N-12W
5N-11W
5N-10W
5N-9W
5N-8W
5N-7W
5N-6W
5N-5W
5N-4W
5N-3W
5N-2W
5N-1W
4N-12W
4N-11W
4N-10W
4N-9W
4N-8W
4N-7W
4N-6W
4N-5W
4N-4W
4N-3W
4N-2W
4N-1W
4N-1E
3N-8W
3N-7W
3N-6W
3N-5W
3N-4W
3N-3W
3N-2W
3N-1W
3N-1E
3N-2E
2N-6W
2N-5W
2N-4W
2N-3W
2N-2W
2N-1W
2N-1E
2N-2E
2N-3E
1N-5W
1N-4W
1N-3W
1N-2W
1N-1W
1N-1E
1N-2E
1N-3E
1N-4E
~ 2015 to 2016
-3.20 to -1.75
-1.75 to -0.50
-0.50 to 0.50
0.50 to 1.75
1.75 to 2.90

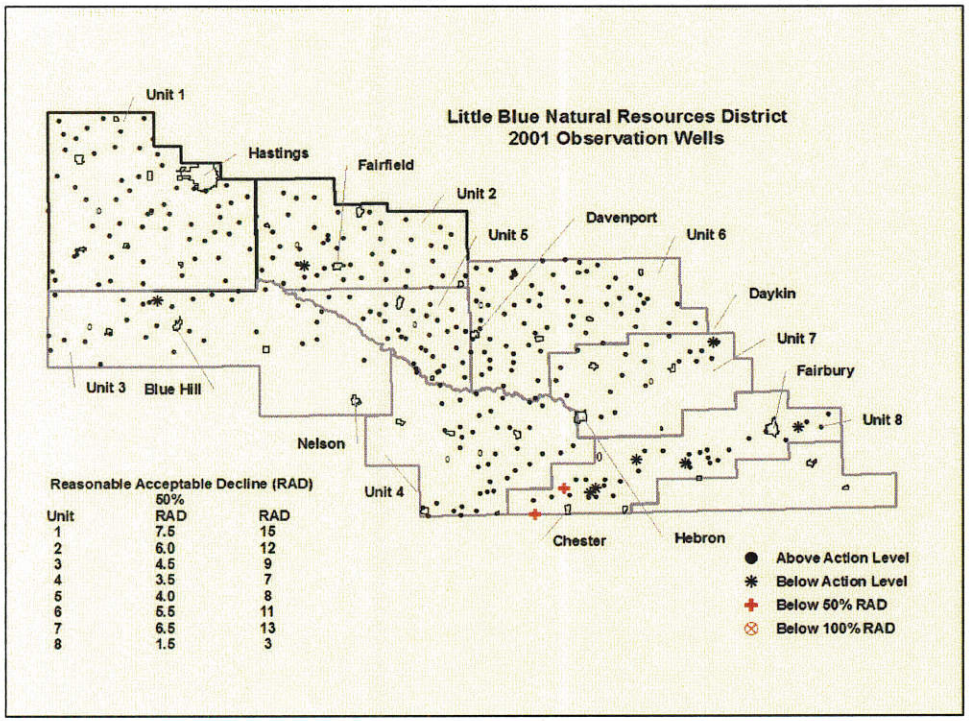
AAA

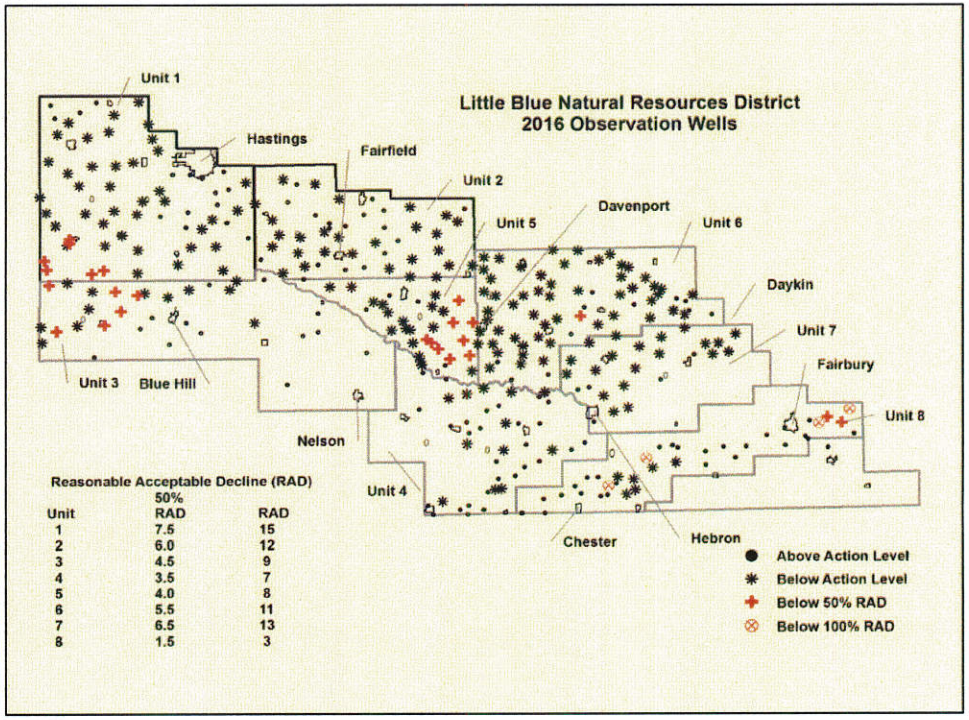

Little Blue Natural Resources District
2016 Spring Static Water Levels
Spring 1975 to 2016
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Unit 6
Unit 7
Unit 8
Unit 1/3
Quantity Sub-Area 8
8N-12W
8N-11W
8N-10W
7N-12W
7N-11W
7N-10W
7N-9W
7N-8W
7N-7W
6N-12W
6N-11W
6N-10W
6N-9W
6N-8W
6N-7W
6N-6W
6N-5W
5N-12W
5N-11W
5N-10W
5N-9W
5N-8W
5N-7W
5N-6W
5N-5W
5N-4W
5N-3W
5N-2W
5N-1W
4N-12W
4N-11W
4N-10W
4N-9W
4N-8W
4N-7W
4N-6W
4N-5W
4N-4W
4N-3W
4N-2W
4N-1W
4N-1E
3N-8W
3N-7W
3N-6W
3N-5W
3N-4W
3N-3W
3N-2W
3N-1W
3N-1E
3N-2E
2N-6W
2N-5W
2N-4W
2N-3W
2N-2W
2N-1W
2N-1E
2N-2E
2N-3E
1N-5W
1N-4W
1N-3W
1N-2W
1N-1W
1N-1E
1N-2E
1N-3E
1N-4E
~ 1975 to 2016
No Data
-15.50 to -11.00
-11.00 to - 6.00
-6.00 to 0.00
0.00 to 11.00
11.00 to 25.00

B

Spring Water Levels
compared to
Action Level, 50% RAD, or 100% RAD

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Above Action Level	301	315	329	308	287	275	223	175	185	274	228	273	277	152	116	115	123
Below Action Level	5	8	13	34	54	64	112	155	146	64	104	63	53	165	194	198	188
Below 50% RAD	0	2	1	2	4	7	7	9	9	3	5	3	2	15	23	20	24
Below 100% RAD	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	3	4
sum	306	325	343	344	345	346	342	339	340	341	337	339	332	334	336	336	339





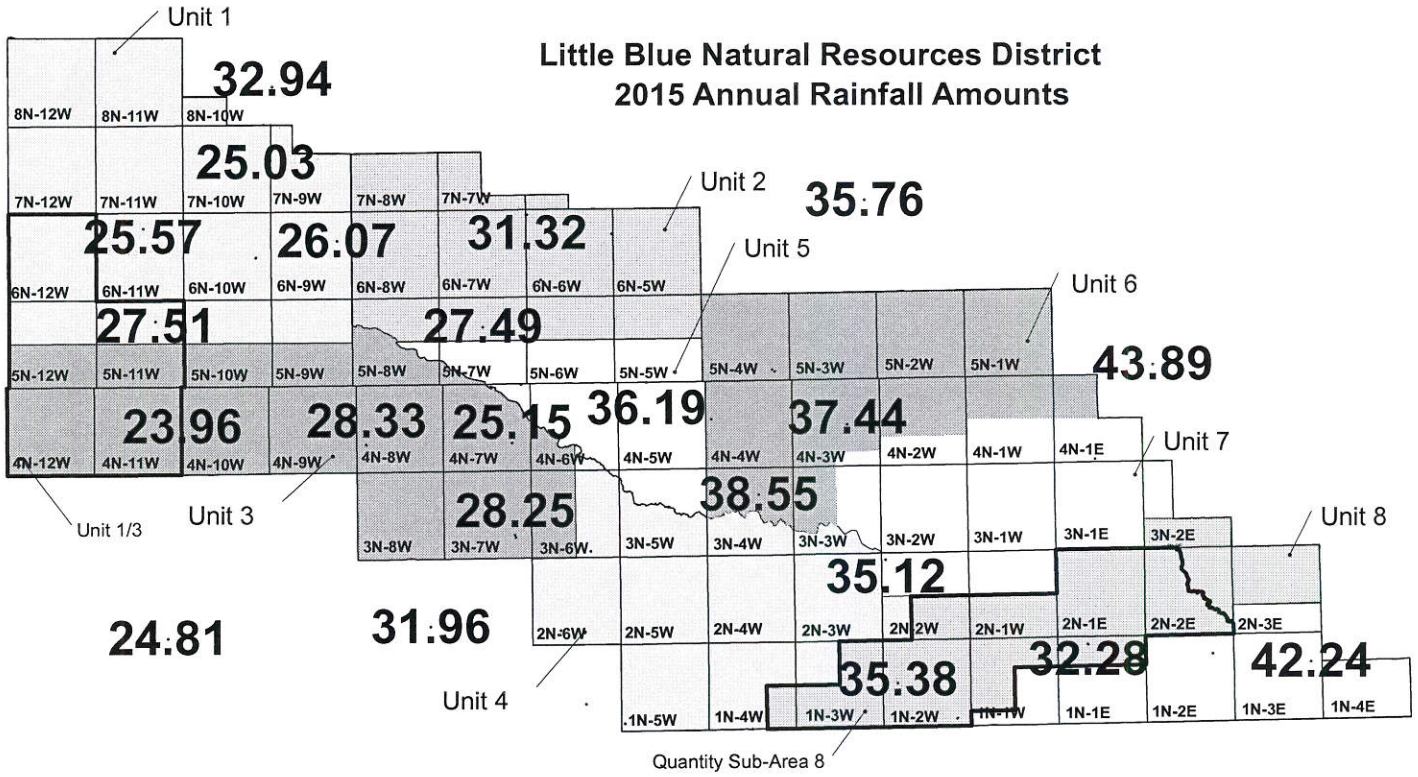
The Action Level is the lowest level prior to 1994 recorded for each monitored well. The 50% Reasonable Acceptable Decline (RAD) is different for each unit and is referenced in the District's Groundwater Management Plan, 50% RAD is measured from the Action Level. The same is true for the 100% RAD. The 50% and 100% RAD are levels in the Groundwater Management Plan where different levels of controls are added to manage the groundwater aquifer. Eighty percent of the monitored wells in any given geographic area are required to be below the respective RAD before moving to Level II or III Quantity Management Activities

C

25.98

26.05

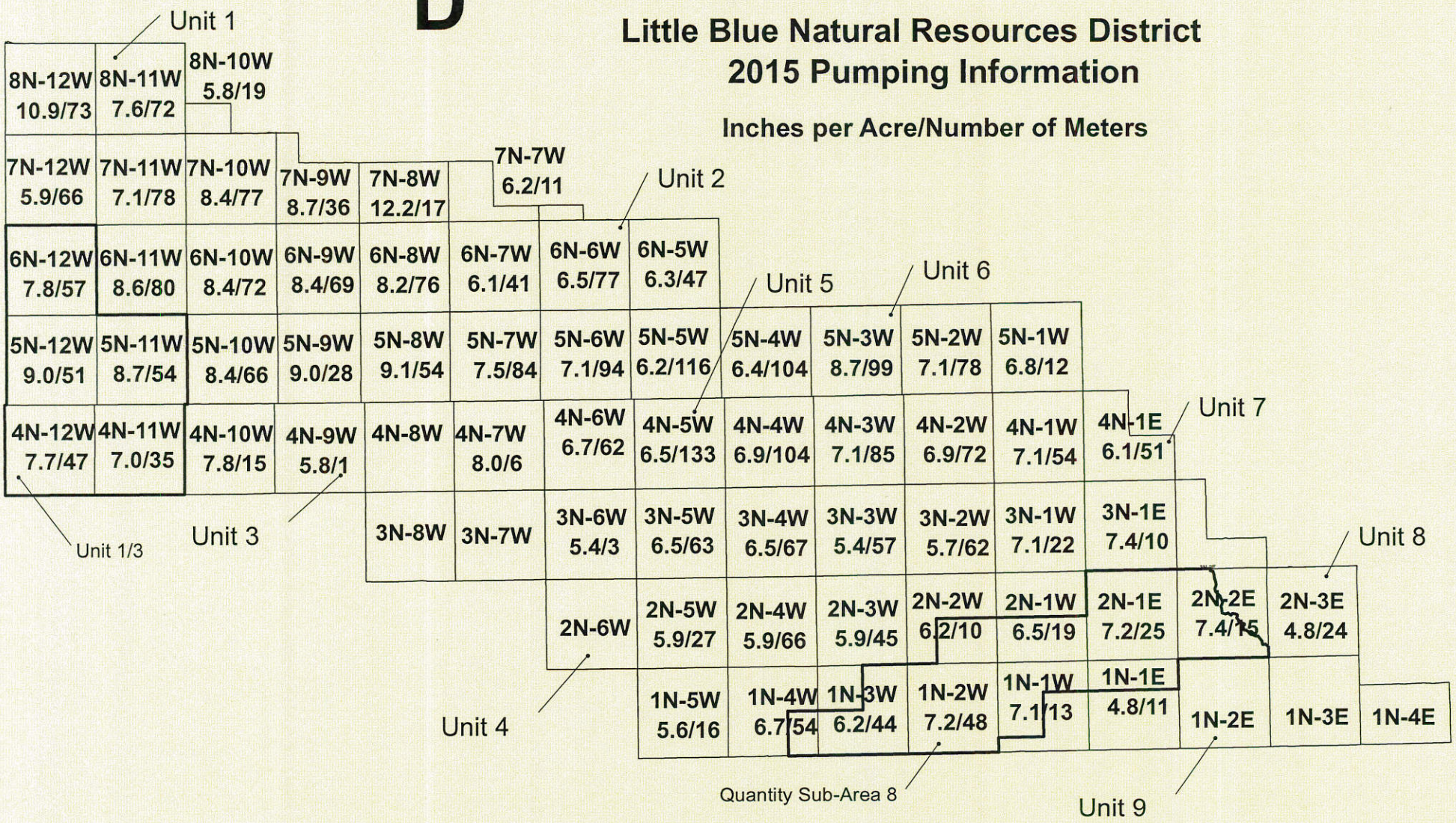
25.71

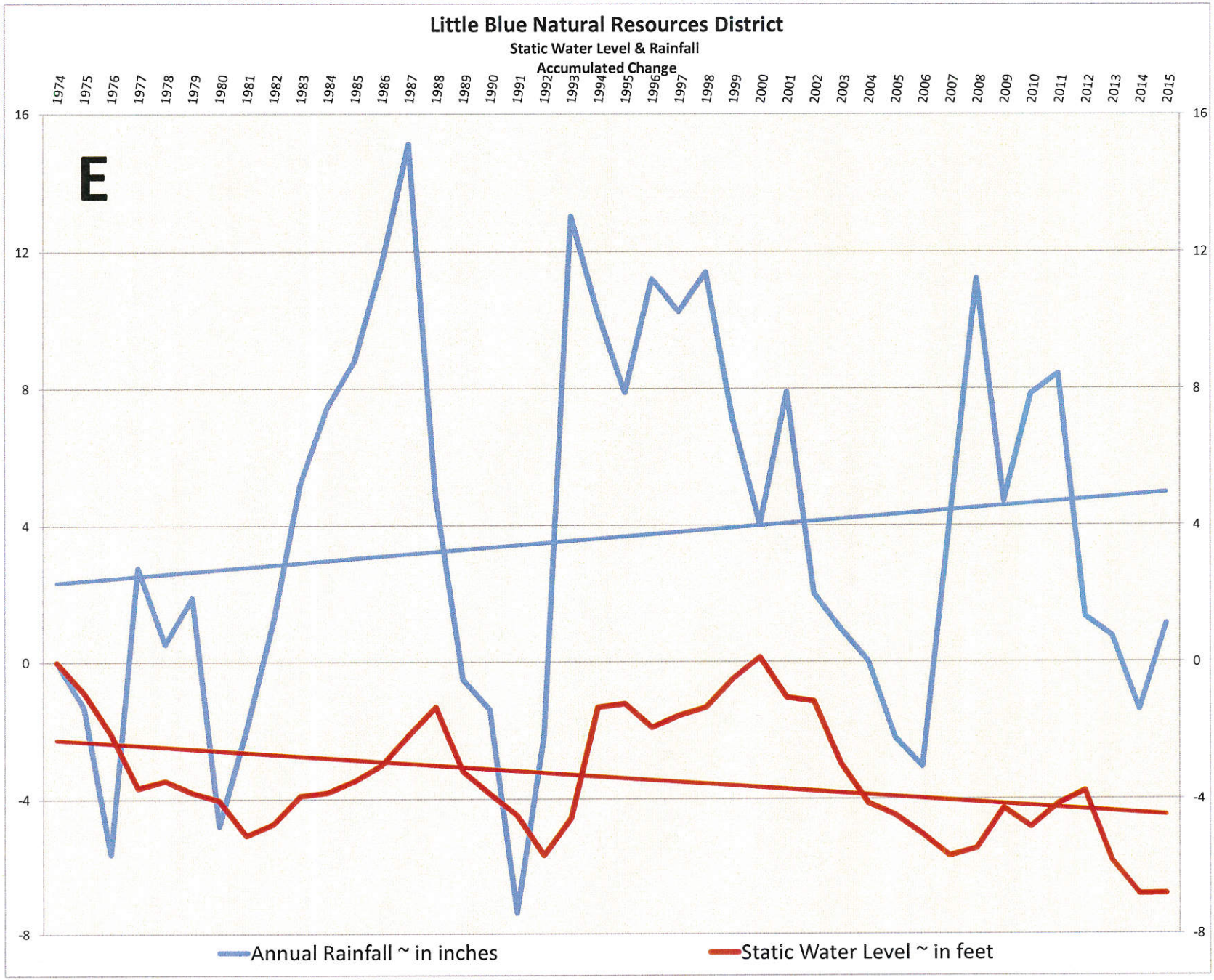


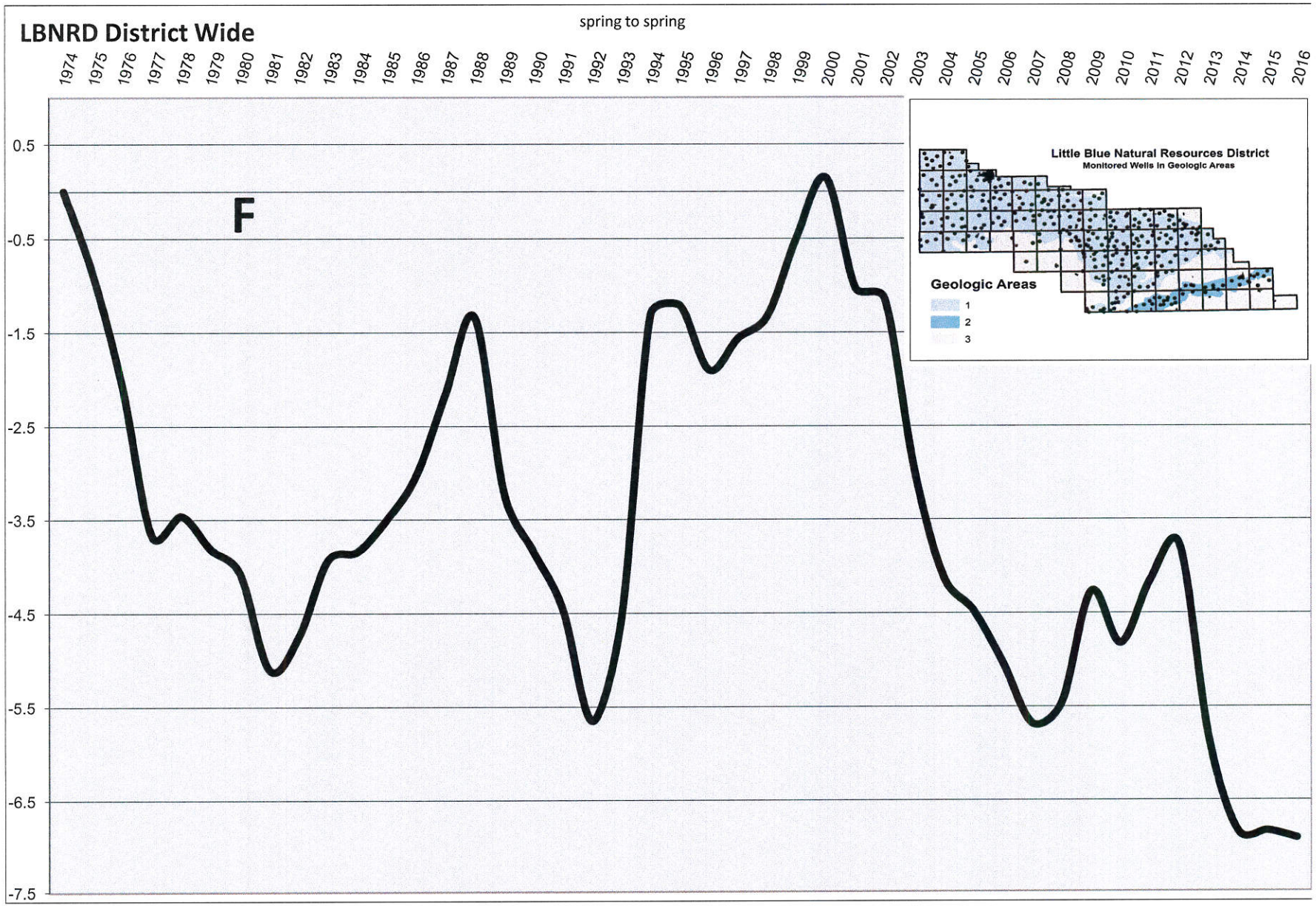
D

Little Blue Natural Resources District
2015 Pumping Information

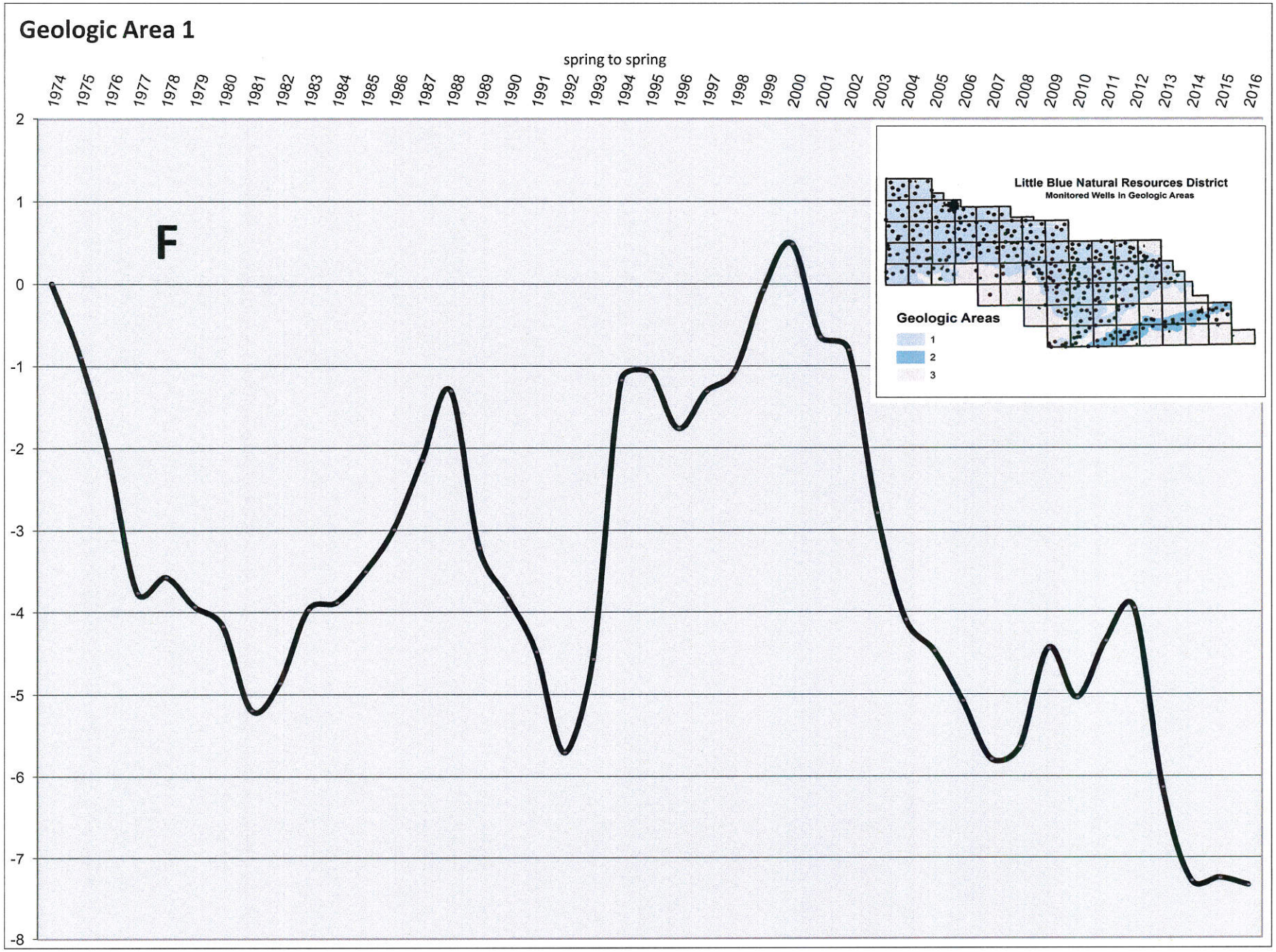
Inches per Acre/Number of Meters




Little Blue Natural Resources District
Static Water Level & Rainfall
Accumulated Change
E
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
16
12
8
4
0
-4
-8
Annual Rainfall ~ in inches
Static Water Level ~ in feet


LBNRD District Wide
spring to spring
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
0.5
-0.5
-1.5
-2.5
-3.5
-4.5
-5.5
-6.5
-7.5
F
Little Blue Natural Resources District
Monitored Wells in Geologic Areas
Geologic Areas
1
2
3

Geologic Area 1



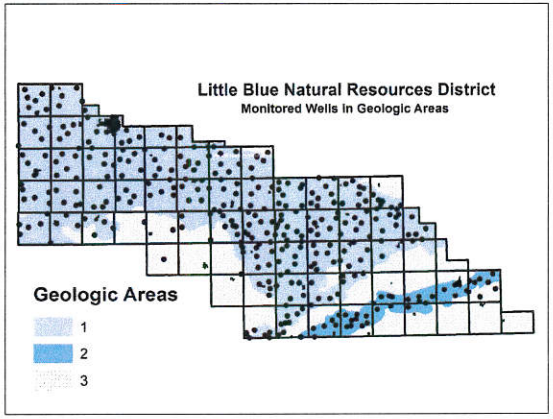
Geologic Area 2

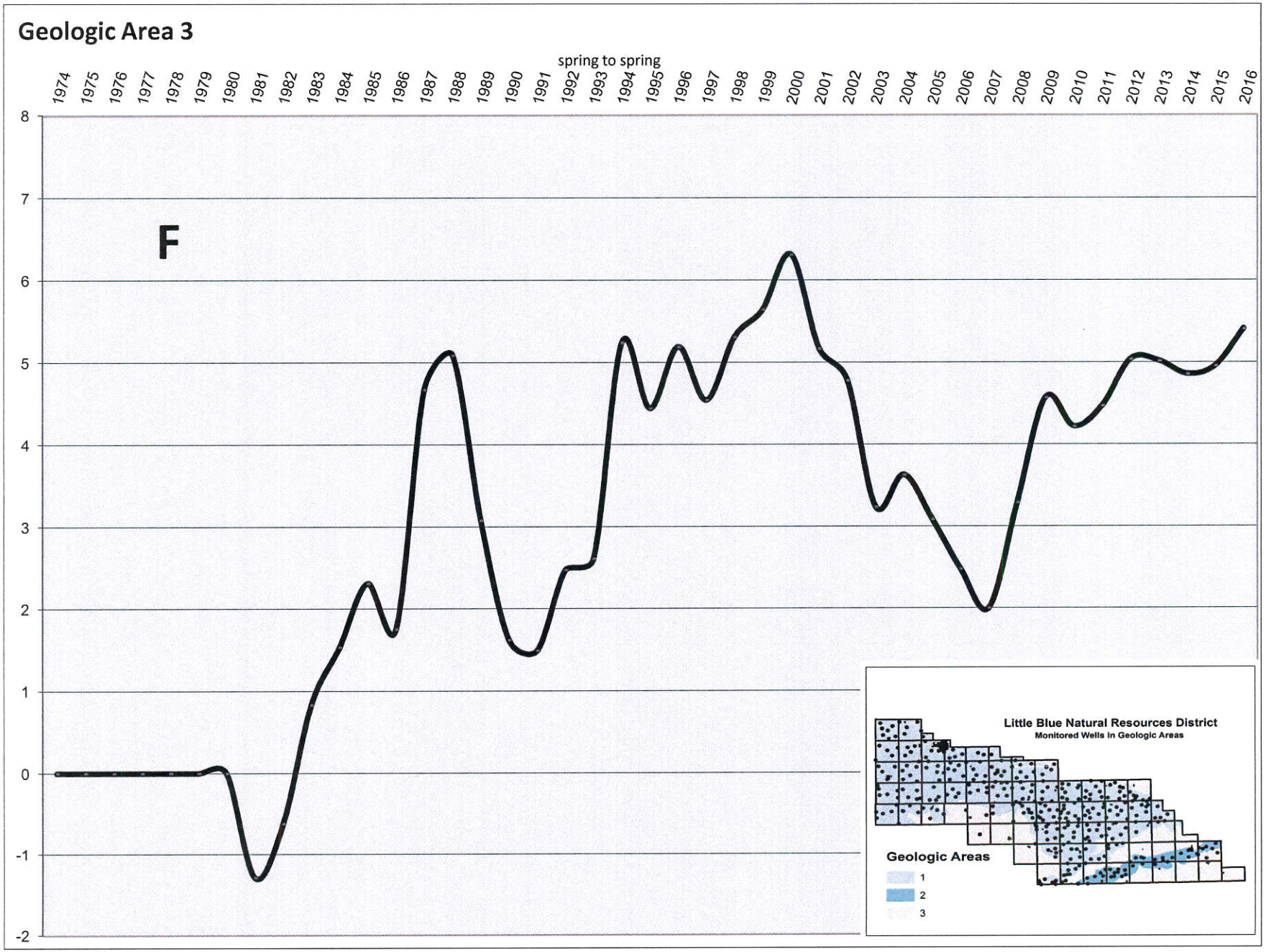
spring to spring

1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016

2
1
0
-1
-2
-3
-4
-5
-6
-7
-8

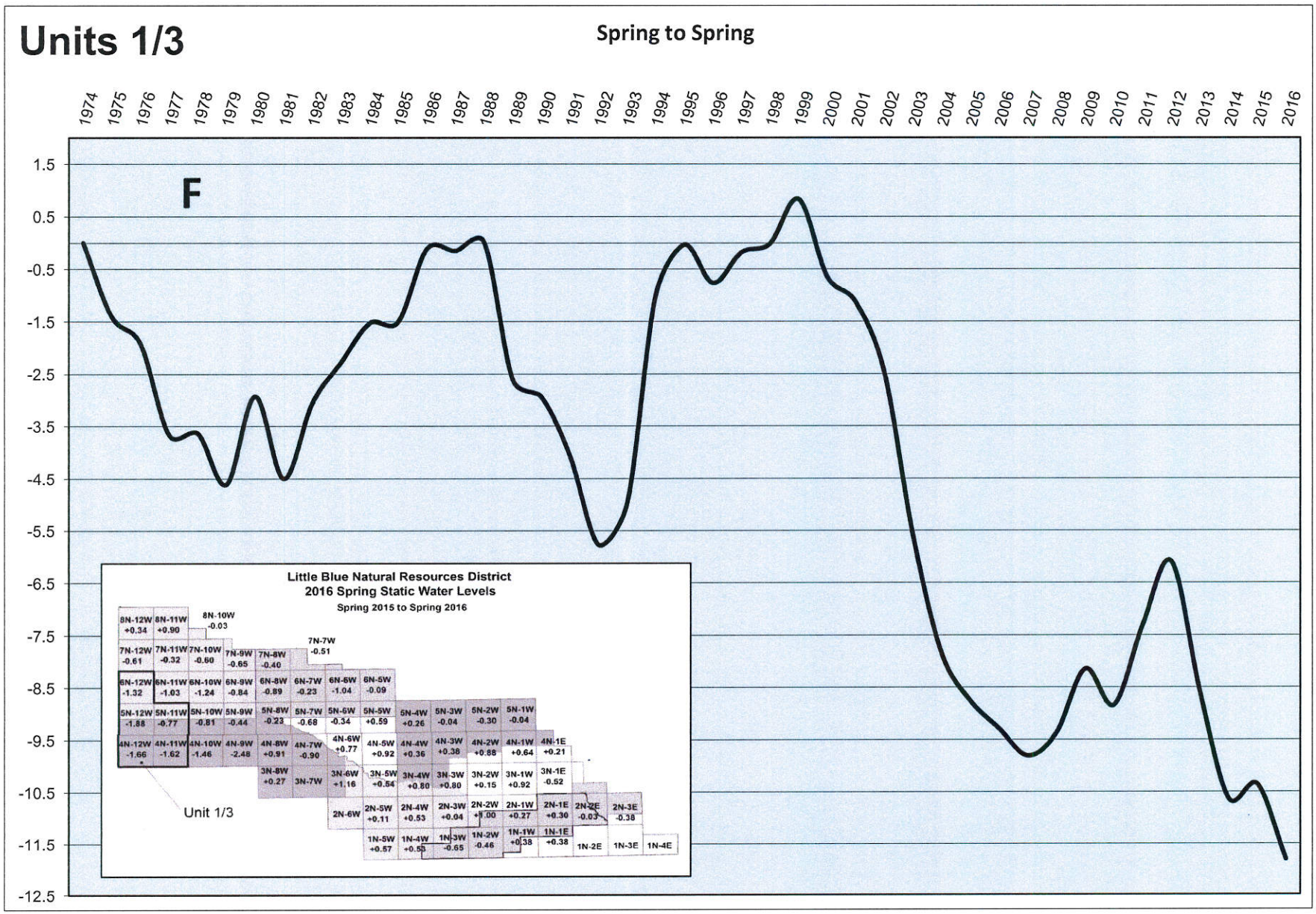
F

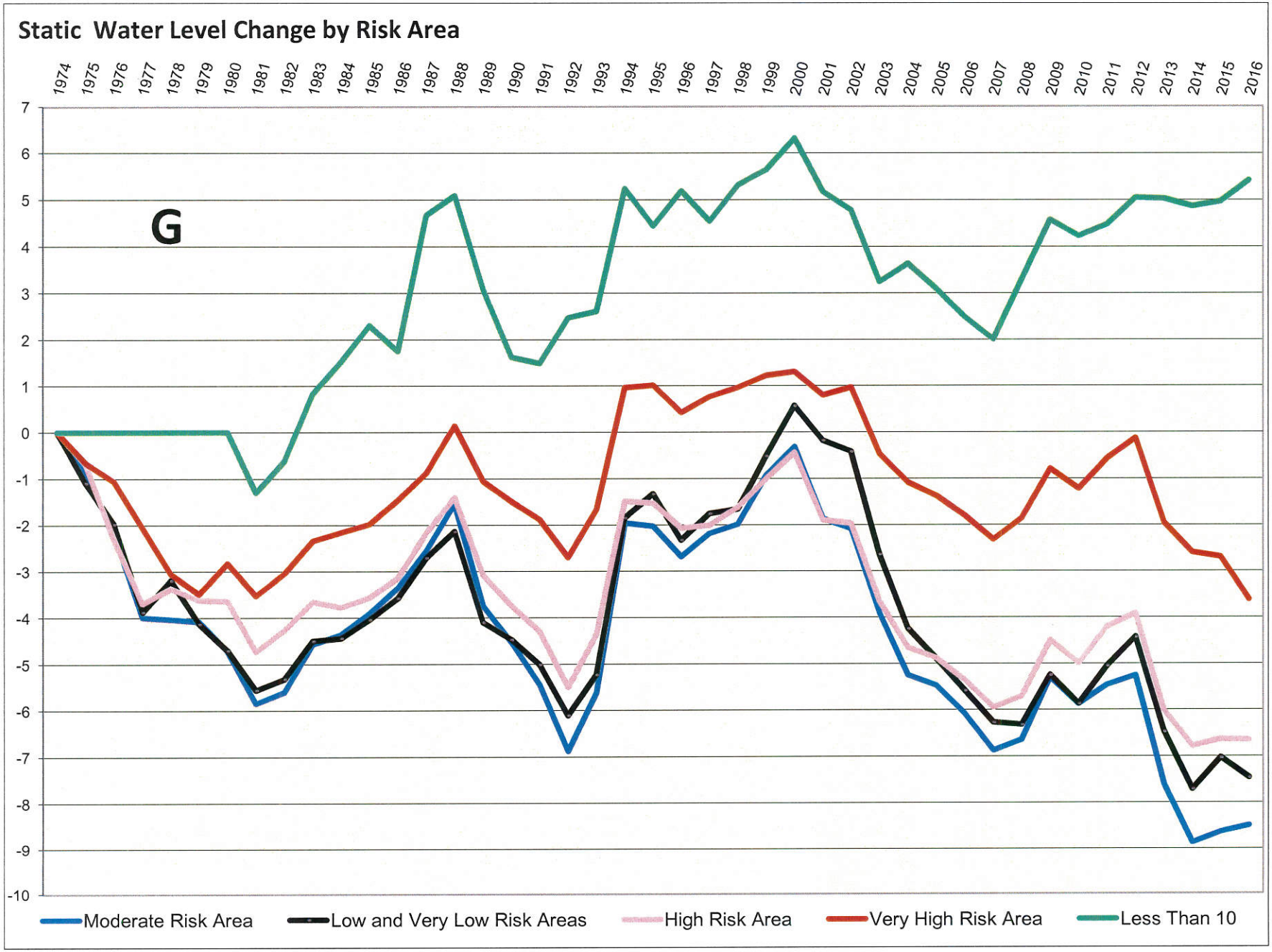



Geologic Area 3
spring to spring
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
8
7
6
5
4
3
2
1
0
-1
-2
F
Little Blue Natural Resources District
Monitored Wells in Geologic Areas
Geologic Areas
1
2
3

Units 1/3

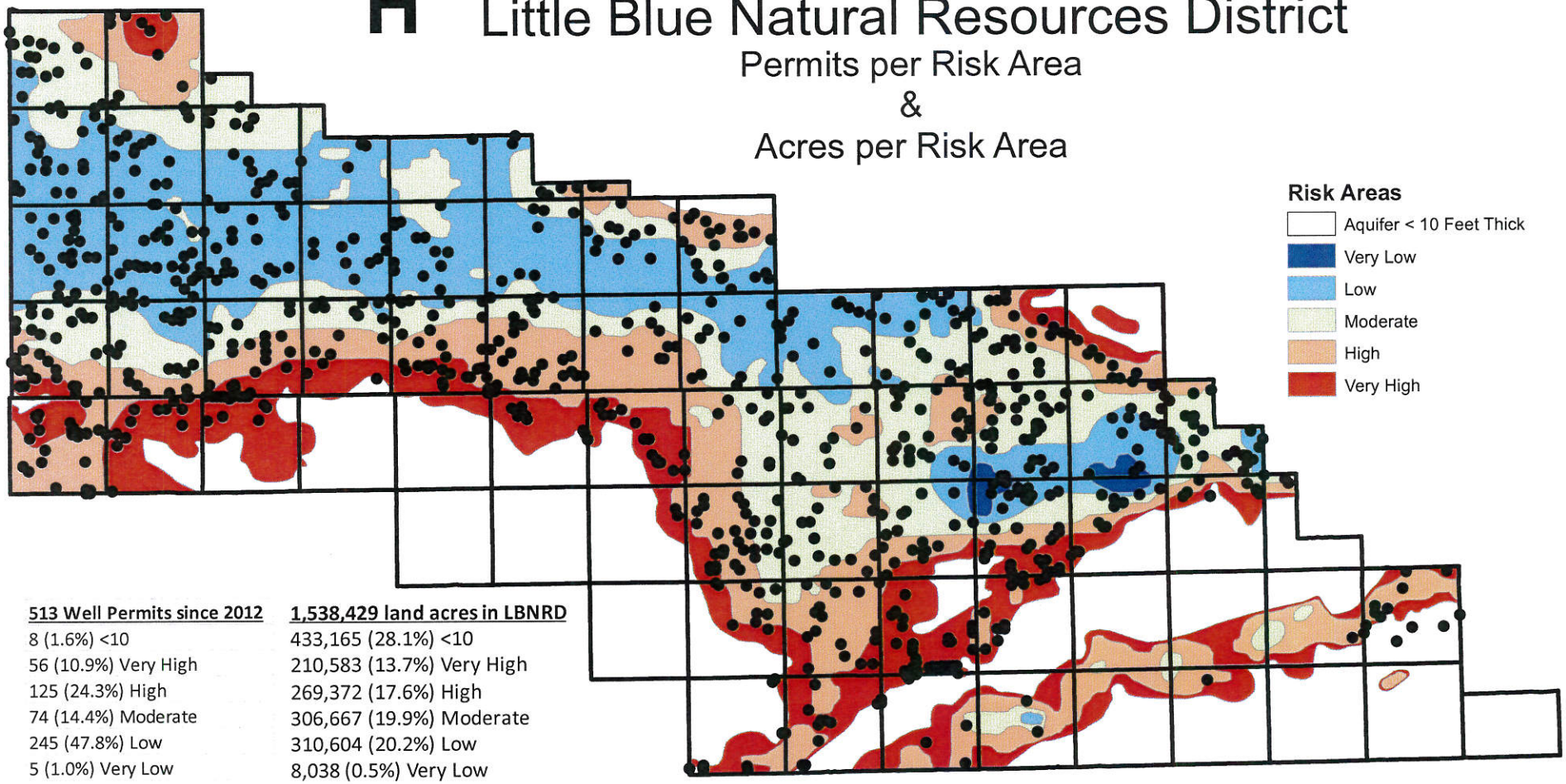
Spring to Spring




Static Water Level Change by Risk Area
G
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
7 6 5 4 3 2 1 0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10
Moderate Risk Area
Low and Very Low Risk Areas
High Risk Area
Very High Risk Area
Less Than 10

H Little Blue Natural Resources District

Permits per Risk Area
&
Acres per Risk Area



513 Well Permits since 2012	1,538,429 land acres in LBNRD
8 (1.6%) <10	433,165 (28.1%) <10
56 (10.9%) Very High	210,583 (13.7%) Very High
125 (24.3%) High	269,372 (17.6%) High
74 (14.4%) Moderate	306,667 (19.9%) Moderate
245 (47.8%) Low	310,604 (20.2%) Low
5 (1.0%) Very Low	8,038 (0.5%) Very Low