DNR MEMO

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April 27, 2004

TO: File

FROM: Kevin J. Schwartman. P.G.

SUBJECT: Republican River Compact Alluvial Mapping Project

The purpose of this project was to update the alluvial boundary of the Republican River valley using new software and data. The alluvial boundary, which outlines the area where wells draw water from Quaternary-aged alluvial fill, is of interest because it can be useful in terms of the Republican River Lawsuit settlement.

The criteria used by DNR staff member Mike Thompson to define the original alluvial map were based on Attachment B to the 1997 Republican River Engineering Committee Report. Attachment B states that "only wells that were drilled within the approved mapped boundaries of the alluvial-fill formation and that derived some or all the pumped water from the alluvial-fill formation at the time the well was drilled should be considered as pumping from the alluvium for (the Republican River) Compact purposes. The alluvial-fill formation is defined as the area of unconsolidated, detrital material of the Quaternary Period that yields sufficient water for a well and that is within the erosional depression bounded by bedrock that does not yield sufficient water for a well, elevated river terraces, escarpments or gentle topographic highs" (Thompson, M., Republican River Compact Alluvial Mapping Project: Memo from September 30, 1997).

Information used to edit the alluvial boundary includes irrigation well data (location and well log information), SSURGO soils, thematic mapper (30 meter multi-spectral satellite imagery), 3% slopes, and DRGs (digital raster graphics/USGS 1:24000 scale topographic maps). I also used a digital version of the Bedrock Geology Map of Nebraska (Burchett, R.R., 1986), a digital test-hole location map and test-hole log reports (all from the UNL Conservation & Survey Division). Additional data and well log information came from the Ground Water Database of the Department of Natural Resources website (http://www.dnr.state.ne.us/). The Groundwater Database is located at: (http://dnrserver26.dnr.state.ne.us/wells/wellsindex.asp).

The two well files used for this project were the **Wells.shp** and the **Rep_Reg_Wells.shp** well files. Both include only wells located within the Republican River valley. **Wells.shp** includes only the irrigation

wells within the Republican River valley and was created for this project. The other well file called **Rep_Reg_Wells.shp,** includes all wells (including commercial, domestic, public...etc) and was created from the 1995 Registered well file (**wells_00.shp**) by removing all of the wells located outside of the Republican River valley. It includes some of the same well data as the **Wells.shp** file, but many of the well locations do not match up either on the map or by legal description. I made adjustments to the alluvial well files to include both well locations in areas where one well appeared in two separate places on the map (hopefully in a way that makes sense lithologically and topographically).

In many areas, I used irrigation well logs to create a series of geologic cross-sections and "sheets" (well logs and short geologic cross-sections) to determine if the boundary should be extended, adjusted, or what parts were to be removed. The geologic cross-sections are based on well locations from the Republic River valley well file (**Wells.shp**). Due to the inaccuracies in the locations as described earlier, it is possible that the distance between wells, the approximate topography, and even the well placement may be off by a short distance. But the lithology and correlative relationships should not be affected and are still useful in determining the generalized subsurface geology of the area.

In determining which wells were to be included within the alluvial boundary, I chose wells that were similar in lithology to those within a mile to 1.5 miles of the Republican River. Nearby wells with similar lithology would most likely have been deposited in a similar depositional environment, the same conditions would have been in place when the alluvium was deposited at both sites. So wells located in the same area deposited in the same environment would, most likely, both be part of the same alluvium. Wells located near tributaries of the Republican River were treated the same, those within 2000 feet of the nearest tributary that had a similar lithology to wells within the alluvial boundary were included and the boundary was adjusted to include these wells if necessary.

Tributaries that flow over the Ogallala group, such as along Frenchmen Creek, were more difficult to determine as some of the alluvium could be similar to the lithology of the Ogallala Group. County test hole logs published by the UNL Conservation and Survey Division were helpful in separating the alluvium from the Ogallala sediments. I found that the wells in these areas were drilled and screened below the alluvium into the Ogallala. So the source of water for these wells was the Ogallala Aquifer, not the alluvial aquifer.

Some wells appeared to have similar lithology but were located in areas that were much higher in elevation than those wells within the alluvial boundary, they were also over 2000 feet from the nearest tributary. I often used DRGs (Digital Raster Graphics or digital topographic maps that are 1:24000 scale from the US Geological Survey) to try to separate alluvial wells from those that may be similar in lithology, but are from a different source. I left out wells that were drilled in topographically high areas that would probably have come from a depositional environment that was different from the alluvial aquifer. Some wells that were located along topographic high spots were included if the elevation was not too great and if the well

was located within 2000 feet of the nearest tributary. If the well was located over 2000 feet from the tributary I considered that to be too great a distance to have been deposited in the same environment.

So the placement of the alluvial boundary was based mostly on the depositional environment of the alluvium in the well. If it was the same wells already included within the alluvial boundary the boundary was adjusted to include that well and the surrounding area. The lithology of the well was most important with other factors taken into consideration such as screening depth, elevation and distance from the Republican River and its tributaries.

Two Geographic Information System or GIS software programs were used to compare the well data, ArcView 3.2 and ArcMap 8.1 (Environmental Systems Research Institute, Inc). Most of the data were assembled and compared using ArcView 3.2 using extensions and tools created by Jeff Shafer. Topographic maps (DRGs) and the well data were easier to access using the tools from these extensions. I was unable to edit the new alluvial boundary shapefile using ArcView 3.2 (map name: republicanalluvium.apr), but could make changes in the alluvial boundary using ArcMap 8.1 (map name: RepublicanRiver_Alluvium.mxd). I could also access the geologic bedrock map and test hole (point) coverages on ArcMap, but through most of this project, these two coverages could not be accessed in ArcView due to differences in the way the data were projected. I later converted the coverages to shapefiles so I could access them in ArcView 3.2. All the data were converted to shapefiles and copied to a CD.

The original memo includes notes that I took describing what areas of the old alluvial boundary were edited and the reasons what wells were added or removed. Following the notes is a list of references, mostly county test-hole Log reports from the UNL Conservation & Survey Division. This is followed by a list of the topographic maps (DRGs). The last part of this memo is a list of various shapefiles associated with this project. Not all of the test-hole reports, DRGs or shapefiles listed toward the end of this memo were necessarily used for this project.

In summary, this map represents an interpretation of the alluvial aquifer based on the data available. This map may not be completely finished, as more data become available; updates can be made to the current version of this alluvial boundary map as necessary.

Production Notes:

Cross-Section A-A' (Nuckolls Co.)
Added Wells: 44211(1-6-29), 58195(1-6-28), 60716(1-6-28), 60714(1-6-29), 47309(1-6-29), 40622(1-6-29), 47307(1-6-29), 58214(1-6-29), 40497(1-6-29), 40621(1-6-30).
All wells have topsoil & clay up to 66 feet thick overlying sand & gravel on top of basal Carlile Shale. Some wells have minor variations including some sand and thin clay layers. Some variations may be due to differing interpretations by drillers. Thicker layers (top soil/clay, sand & gravel, shale) can be easily correlated with each other on the cross section and with well 47308(1-6-20), which is within the old alluvial boundary.

Cross-Section A-A'' (Nuckolls Co.)
Added Wells: 47306(1-6-19), 40623(1-7-24)
Same lithology as above, continues to the west of cross-section A-A'.
Cross-Section B-B'**Version #1** (Nuckolls Co.)
Cross-Section B-B'**Version #2**/Cross-Section B-B'' (Nuckolls Co.)
Added Wells: 84759(1-7-20), 82273(1-7-20), 84757(1-7-20), 54638(1-7-20)
The lithology of this area is similar to cross-section A-A' to the east. Cross-section B-B'(version #1) shows good correlation from the southern most well (84759) to the northwest, but there is some confusion involving the one well that lies in the old alluvial boundary (84758). In cross-section B-B'(version #2)/B-B'' the correlation is much clearer (more obvious). They are made up of the same wells, but in differing order. Cross-section B-B'(version #2) starts in the south (at well 84759) and goes toward the northwest to well 54638 without jogging to the east to well 84758, which is closest to the stream (about 250 feet above the terrace) and located within the old alluvial boundary. Cross-section B-B'' includes only the southern well (84759) and the well closest to the stream (84758).

Sheet A (Nuckolls Co.)
Added Wells: 81432(1-8-14)
Fits general pattern of basal sand & gravel with overlying clay below more sand & gravel below clay and topsoil. Test hole 1-A-39 and well 83438(1-8-23) has been added to sheet A for comparison.

Cross-Section C-C' (Nuckolls Co.)
Added Wells: 87725(1-8-6), 87724(1-8-6), 87722(1-8-6)
Cross-Section C-C' goes from the floodplain south of the Republican River (well 84299/1-8-19) to the northeast and north. The basal gravel correlate fairly well between all the wells. Some variation in lithology may be due either to the depositional history or possibly interpretation by the driller. Test hole 96-B-47 is included between the first two irrigation wells (87725 & 87724) for comparison. They correlate very well, especially in the lower part of the section.

Cross-Section D-D' (Webster Co.)
Added Wells: 19791(1-9-2), 87723(1-9-2), 19791(1-9-3), 19791(1-9-3?)
Only wells 87723, 51879 (within old alluvial boundary) and two test holes (6-G-34 in the floodplain and 8-U-39 located farther up the hill) are included in the geologic cross-section. The other three wells were not included in the geologic cross-section. All three wells have the ID #19791, registration number G-014340, and the same

lithology (20' of clay overlying 30' of sand & gravel). Only one (19791/1-9-3) is listed in the Ground Water Data Base on the DNR Web Site. The other well listed as 19791(1-9-3?) above also has a legal description that does not correspond with its location on the map. All three are included in the new alluvial boundary since at least two have legitimate legal descriptions and the third (that does not) is close enough to well 87723 that it will automatically by included.

Sheet B (Webster Co.)
Added Wells: 56190(2-9-32), 56190(2-9-32)
Lithology correlates with well in the old alluvial boundary with well 59841. The new boundary was extended up the stream valley.

No Cross-Section (Webster Co.)
Added Wells: 79909(2-9-23), 79909(2-9-23)
Both wells have 5' of topsoil & sand, 69' of sand & gravel over basal Niobrara) Chalk.

No Cross-Section (Webster Co.)
Added Wells: 37334(2-9-30), 60198(2-9-30)
Well 37334 has 9' topsoil & clay over 117' sand & gravel overlying 14' limy clay and shale. Well 60198 has 9' topsoil & clay over 66' sand & gravel, 1' clay, 4' sand & gravel, 6' clay, 7' medium sand & gravel overlying 7' ochre & shale. No nearby wells within the old boundary, but these fit the general pattern similar to other wells included in the alluvial boundary.

No Cross-Section (Webster Co.)
Added Wells: 2078(2-10-36), 13894(1-9-6)
Well 2078 has 13' topsoil & clay over 21' gravel, 4' clay, 32' gravel overlying 1' clay & shale. Similar to well 41946 (same section to the northwest), which is within the alluvial boundary.
Well 13894 has 5' topsoil over 19' sand & gravel, 11' gravel. Located in the same general area (to the southeast of well 2078). Consistent lithology to most wells in the alluvial boundary.

Sheet C (Webster Co.)
Added Wells: 64290(2-10-13), 37431(2-10-13), 40804(1-10-24), 40805(2-10-13)
All have thick layers of sand & gravel and very little clay. Some variation between wells, including find sand (well 4084), but most likely part of the alluvium. Well 40805 is located on a topographic high spot (1830' elevation) between the tributary valleys. I was not sure if it would be included, but it is so close in lithology to the nearest well (64290) and is only about 20' higher in elevation, so it will be included in the new alluvial boundary.

Sheet D (Webster Co.)
Added Wells: 55967(2-10-11), 37332(2-10-14), 62539(2-10-14), 60200(2-10-14), 60200(2-10-14)
All wells are located close to a stream or tributary. They also have the generalized pattern/good correlation associated with well within the alluvial boundary.

Sheet E (Webster Co.)
Added Well: 74112(2-10-15)

Has thick layers of sand & gravel with some clay and sand. Fair correlation with a nearby test hole (29-33/2-10-15) and another well located on a topographic high spot (well 37331/2-10-15). The test hole and well 37331 correlate better with each other than with well 74112. Although well 37331 has lithology that is consistent with other wells located in the alluvial boundary its location on the high ground between tributaries suggests it may not be part of the alluvial aquifer, so will not be included in the alluvial boundary.

Cross-Section E-E' (Webster Co.)
Added Wells: 78392(2-10-26), 56832(2-10-26), 88436(2-10-26)
All the wells included on the geologic cross-section correlated well with each other except well 37330(2-10-26), which was not included in the new alluvial boundary. The wells listed above also correlate well with well 73040 that is located within the old alluvial boundary in the **Wells.shp** file location. According to the other well file (**Rep_Reg_Wells.shp**), well 73040 is not located within the old boundary. So adjustments were made to include it. Well 78392 was also included based on its location in **Rep_Reg_Wells.shp**, which I believe has a more accurate placement than the **Wells.shp** file.

Sheet F (Webster Co.)
Added Well: 76095(2-10-22), 61036(2-10-27)
Both wells correlate well with other wells in the alluvial boundary. There is a little variation in well 61036, but still has the thick sand & gravel layers similar to the other wells of interest. Also, according to its placement in the **Rep_Reg_Wells.shp** file, it is already in the alluvial boundary.

No Cross-Section (Webster Co.)
Added Wells: 56347(3-10-33), 57258(3-10-33)
Both wells correlate well with well 57259(3-10-33) that is already in the alluvial boundary (according to **Rep_Reg_Wells.shp** all three were within the boundary, so no adjustment may have been necessary).

No Cross-Section (Webster Co.)
Added Well: 56346(2-10-4)
Lithology fits the general pattern of most of the wells included in the alluvial boundary, it is also located near an adjoining tributary. Another well (56345/2-10-5) that will not be included has a slightly different lithology and is located on a topographic high spot farther up another tributary too far to be included in the new boundary.

Cross-Section F-F' (Webster Co.)
Added Wells: 66426(3-10-30), 66427(3-10-31), 66428(3-10-31), 66429(3-10-31)
All are fairly close to the old alluvial boundary and correlate well with each other and with the general pattern of most wells in the alluvial boundary. Adjustments were made to include wells for both map locations (**Rep_Reg_Wells.shp** and **Wells.shp**).

Sheet G (Webster Co.)
Added Wells: 66430(3-10-31), 66431(3-10-31)
Just west of wells in geologic cross-section F-F'. Lithology correlates fairly well. Well 66430 is located near (and in **Rep_Reg_Wells.shp** it is located in) bottomland soil deposits.

Cross-Section G-G' (Webster Co.)
Added Wells: 34050(2-12-11), 52430(2-12-13), 64583(2-12-13), 46229(2-12-13), 46230(2-12-13)
All the wells correlate fairly well with each other. Well 34505 has a similar lithology and is also located in an area that is not far from a streambed and terrace deposits. The boundary may be more extensive than necessary, as most of the wells from each shapefile (**Wells.shp** and **Rep_Reg_Wells.shp**) do not match up together. Also some of the legal description in both files do not appear accurate.

Sheet H (Webster Co.)
Added Wells: 57456(2-11-11), 24991(2-11-11), 34050(2-12-11)
Well 57456 lies very close to the old alluvial boundary, the lithology is also very simple, though not correlative to the other wells. Well 24991 is made up mostly of interbedded sand and sand & gravel layers; it also lies close to terrace deposits and a stream. Well 34050 also doesn't correlate real well with the other two but was included in geologic cross-section G-G' (see above).

No Cross-Section (Webster Co.)
Added Wells: 70983(3-11-26), 71384(3-11-27)
Lithology is different between these two wells. Well 70983 is fairly consistent with other wells within the alluvial boundary, but is located on a topographic high spot. I extended the boundary up the streambed (as done on several other edits). Well 71384 has a lot of gravel, some mixed with clay. It is located near the junction of two tributaries. Also, in the **Rep_Reg_Wells.shp** file, well 71384 is already located within the alluvial boundary.

No Cross-Section (Webster Co.)
Added Wells: 73492(3-11-23)
The lithology is consistent with other wells within the alluvial boundary and is located just outside the old boundary. Also, in the **Rep_Reg_Wells.shp** file, well 73492 is already located within the alluvial boundary.

No Cross-Section (Webster Co.)
Added Wells: 49933(3-11-15), 65366(2-11-9), 57890(2-11-15),
In the **Rep_Reg_Wells.shp** file, wells 49933 and 65366 are already located within the alluvial boundary, but in the **Wells.shp** file they are just outside the boundary. These wells have a similar lithology to wells within the alluvial boundary. Well 57890 is mostly made up of sand & gravel.

No Cross-Section (Webster Co.)
Added Wells: 68777(3-12-25), 64732(3-12-36)
Both are made up mostly of sand & gravel similar to other wells within the alluvial boundary.

No Cross-Section (Webster Co.)
Added Wells: 58028(3-12-27)
Made up mostly of sand & gravel.

No Cross-Section (Webster Co.)
Added Wells: 52431(2-12-9)
Made up mostly of sand & gravel with thin clay layer, also just upslope from terrace deposits.

No Cross-Section (Webster Co.)
Added Wells: 78404(2-12-20), 69966(2-12-21)
Made up mostly of sand & gravel and are fairly close to the original alluvial boundary. Well 78404 is just upslope from terrace deposits and well 69966 is very close to a streambed. Each well correlates well with other wells in similar environments.

No Cross-Section (Franklin Co.)
Added Wells: 55957(3-13-24)
Has 120 feet of sand & gravel upslope from the terrace deposits.

No Cross-Section (Franklin Co.)
Added Wells: 73355(3-13-27)
Thick gravel with a thin clay layer. A well northeast (107083) was not included because its lithology wasn't consistent with 73355 and it is also located on a topographic high spot.

Sheet I (Franklin Co.)
Added Wells: 93249(3-13-35)
Not identical to nearby wells such as well 68563 (to the south and east) but close enough to be included in the alluvial aquifer. Both tributaries are included because of differing well locations according to the two well files.

No Cross-Section (Franklin Co.)
Added Wells: 62639(3-13-29), 68242(3-13-32), 68243(3-13-32), 34119(3-13-32)
All are mostly gravel with some clay layers except well 34119, which has both sand and sand & gravel with some clay layers. All are also fairly close to the streambed.

No Cross-Section (Franklin Co.)
Added Wells: 30568(3-13-32)
Made up of 35 feet of clay overlying 34 feet of gravel. Although very shallow, the lithology appears to be consistent with other nearby wells. Also located fairly close to terrace deposits.

No Cross-Section (Franklin Co.)
Added Wells: 34094(2-3-6)
Has a similar lithology to well 34119 (to the northeast) and well 40452 (within the alluvial boundary to the south-southeast). Mostly sand with sand & gravel near the base of the well. Also very close to some bottomland.

Sheet J (Franklin Co.)
Added Wells: 68756(2-14-22), 68755(2-14-22), 68754(2-14-22), 68753(2-14-22), 68752(2-14-22), 68751(2-14-22), 68750(2-14-22), 68749(2-14-22)
All have a thick layer of gravel with slight differences in lithology at the top and along the base of the well (possibly due to differences in interpretation by the drillers). All are consistent to wells in other areas that are within the old alluvial boundary. The new boundary was adjusted to include the wells as they occur according to both well files. **Wells.shp** file shows the wells strung out in an east-west line whereas the **Rep_Reg_Wells.shp** file has the well in two clusters south of the east to west line in the **Wells.shp** file. The

first cluster includes wells 68756 to 68751 and wells 68750 and 68749 are located about 1300 feet to the east. As usual, I suspect that the **Rep_Reg_Wells.shp** file is the more accurate of the two well files.

No Cross-Section (Franklin Co.)
Added Wells: None
68760(2-14-21), 68761(2-14-21), 68762(2-14-21) All have identical lithologies (4 feet topsoil and 32 feet of clay overlying 51 feet on sand & gravel on top of shale). The wells are located on a topographic high spot and the well information states that the water is being pumped from the shale, not from the alluvium, so they will not be added.

No Cross-Section (Franklin Co.)
Added Wells: 58842(2-14-19), 57766(2-14-19)
Both have similar lithologies to other wells in the area, including thick sand & gravel layers.

No Cross-Section (Franklin Co.)
Added Wells: 73818(2-15-14)
Follows the usual pattern of thick sand & gravel with some interbedded clay layers. It is located in a spot that is topographically high, but still fairly close to the streambed.
Seven wells located some distance to the north of this area (wells 72110/3-15-4, 72221/3-15-9, 72821/3-15-9, 30020/4-15-7, 75565/4-15-2, 69330/4-15-1, 69329/4-15-1) are far away and too lithologically different from wells in the old alluvial boundary to be included.

No Cross-Section (Franklin Co.)
Added Wells: 45603(2-16-20), 42782(2-16-22)
These wells have thick sand & gravel layers along with some sand and clay layers and both are fairly close to the old alluvial boundary. Well 42782 may or may not be drawing water from the Ogallala, which occurs in the area. There is no good way of determining how deep it occurs in the stratigraphic section from the well log. It will be included since it the well is located close to the riverbed.
Three wells located far to the north of this area (Wells 55739/3-16-9, 55740/3-16-16, 29845/3-16-22) have lithologies that are similar to other wells within the alluvial boundaries, but they are located far from the newest boundary in topographic high areas.

No Cross-Section (Phelps Co.)
Added Wells: None
Wells 71823(5-20-21) and 42727(5-20-21) have lithologies that are consistent with wells in the alluvial boundary but are upstream from several wells in Harlan County that have very little alluvium (including wells 68415/4-20-4 and 73943/4-20-9 see below) that are obviously drawing water from the Ogallala. It cannot be determined if the water from these wells is being drawn from alluvium or the Ogallala, so adjustments were made to remove the boundary from this tributary.

No Cross-Section (Harlan Co.)
Added Wells: None
Well 106800/4-1427278-25 has not been added the location. According to the **Wells.shp** file is too far and at a topographic high spot and although the location for the **Rep_Reg_Wells.shp** file is closer, but according to the well information, the pumping level is deep enough

that it is probably drawing water out of the Ogallala Group. One well to the southeast (well 112308/4-17-31) and two others farther to the northeast (wells 60402/4-17-10 and 77546/4-17-10) are also located too far and on a topographic high area.

No Cross-Section (Harlan Co.)
Added Wells: None
Well 39287(2-18-29) has a lithology that is not really consistent with most wells within the alluvial boundary, it also sits on a topographic high spot. Another well (70138) that appears to be in the same area according to the **Wells.shp** file but does not appear in the area in the **Rep_Reg_Wells.shp** file. It seems the legal description is different in each file: 2-18-30 in the **Wells.shp** file and 2-17-30 in the **Rep_Reg_Wells.shp** file. So it occurs one range to the east. Neither will be included.

Sheet K (Harlan Co.)
Added Wells: 49266(2-18-5)
Appears to correlate well with well 81994(3-18-32), which is within the old boundary. But descriptions for both well logs were incomplete and poorly documented. It will be included anyway.

No Cross-Section (Harlan Co.)
Added Wells: 106667(3-18-17)
Mostly sand & gravel, similar to most wells within the alluvial boundary.

No Cross-Section (Harlan Co.)
Added Wells: 76160(3-18-11)
Another well with poorly documented lithology. But it is fairly close to some bottomland deposits and seems to have the correct lithology to be included. Another well a little over a half-mile to the east (well 76159/3-18-10) also has an incomplete lithologic well log and is located on a topographic high spot, it will not be included.

No Cross-Section (Harlan Co.)
Added Wells: 31884(4-18-35)
Has a thick layer of sand & gravel below a very thick layer of clay (underlying a thin sand layer). Also is very close to the old alluvial boundary.

No Cross-Section (Harlan Co.)
Added Wells: 55573(4-18-15)
Has thick gravel below clay and sand. Another well to the northwest (77049/4-18-6) is fairly close to the old alluvial boundary, but the lithology is not consistent with other wells within the boundary (a lot of sand but not much gravel). This well will not be included and the old boundary will be pulled back to the area around well 55573.

No Cross-Section (Harlan Co.)
Added Wells: None
Well 70083/2-17-18 was removed since I suspect that it draws water from the Ogallala.

Sheet L (Harlan Co.)
Added Wells: 48613(3-19-33), 75857(3-18-21)

Both have similar lithologies and are located near the streambed. Another well to the north and west (95737/3-18-9) has a similar lithology, but different enough to make it questionable. Since it is also located on a topographic high spot away from the original alluvial boundary, it will not be included.

Sheet M (Harlan Co.)
Added Wells: 68414(3-20-23), 70370(3-20-23), 73541(3-20-23)
Correlation between the wells is not perfect, but close enough to the general lithologic pattern to be included. Boundary was also adjusted to include terrace and bottomland soil deposits.

Cross-Section H-H' (Harlan Co.)
Added Wells: 27572(3-20-13), 84214(3-20-13), 84215(3-20-13), 30370(3-20-24), 46846(3-20-24)
The lithology of these wells is fairly consistent with most of the wells within the alluvial boundary.

No Cross-Section (Harlan Co.)
Added Wells: 74035(4-19-28), 29374(4-19-8)
Both have thick layers of sand & gravel. They are too far away from each other to correlate lithology but are each close enough to the riverbed to be included. Well 74035 may be questionable since, according to the well information, the pump level suggests it is drawing water from clay and limestone. I have included this well since the water may be recharged from the overlying sand & gravel. Boundary also extended to include bottomland and terrace deposits.

No Cross-Section (Harlan Co.)
Added Wells: 31130(3-19-2)
Has two thick layers of sand & gravel, also very close to the old boundary within terrace deposits (already within the alluvial boundary in the **Rep_Reg_Wells.shp** file, boundary adjusted to include location in the **Wells.shp** file).

Cross-Section I-I' (Harlan Co.)
Added Wells: None
The geologic cross-section I-I' includes wells: 20437(3-20-10), 27068(3-20-3), 26804(3-20-2), 68674(4-20-35), 75634(4-20-35), and 44476(4-20-35). Wells 20437, 26804, and 44476 are already within the alluvial boundary. The other three have lithologies that are inconsistent with other wells within the alluvial boundary and are located on topographic high spots; they will not be included.

No Cross-Section (Harlan Co.)
Added Wells: None
North of the area covered by geologic cross-section I-I' are two wells (98787/4-20-27 and 98179/4-20-27) that have lithologies that do not correlate well with the nearest well (12998/4-20-26) within the alluvial boundary. They are also on topographic high spots and will not be included in the new alluvial boundary.

Sheet N (Harlan Co.)
Added Wells: 62253(4-20-14), 113440(4-20-1)
Well 113440 has a thick sand & gravel layer and is located within terrace deposits. Well 62253 is farther to the south and has thick beds of sand & gravel. A nearby well (48655/4-20-14) has a lithology

that doesn't correlate well with 62253 or other wells within the alluvial boundary.

Sheet O (Harlan & Gosper Co.)
Part I = Harlan Co.
Added Wells: None
Neither well 22622/4-20-16 nor 93442/4-20-8 (Harlan County) correlate well with other wells within the alluvial boundary. Well 22622 is located within terrace deposits but the lithology doesn't fit the general pattern of most wells in the alluvial boundary. Also, according to the well information, the pumping level is below sandstone and shale that may be part of the Ogallala Group. This may also be true for well 93442

No Cross-Section (Harlan Co.)
Added Wells: None
Wells 68415/4-20-4, 73943/4-20-9 and others along the same tributary seem to have little alluvial material overlying the Ogallala Group sediments. A couple of wells to the north and west in Phelps County (71823/5-20-21 and 42727/5-20-21 see above) have also been left out. It cannot be determined if water in these wells is being drawn out from alluvium or Ogallala material.

No Cross-Section (Harlan Co.)
Added Wells: None
Wells 62285(4-20-18) and 62286(4-20-18) were removed because, according to the well information, they are drawing water from the Ogallala Group.

Sheet O (Harlan & Gosper Co.)
Part II = Gosper Co.
Added Wells: None
Wells 47282(5-23-35) and 43593(5-23-26) seem to draw water from the Ogallala sediments. They will be removed along with the wells upstream (see below).

No Cross-Section (Harlan Co.)
Added Wells: None
Wells 3845(6-23-23), 54773(6-22-30) and 53239(5-23-1) were removed because they were apparently drawing water from the Ogallala much like wells 47282/5-23-35 and 43593/5-23-26 (see above). The entire tributary will be removed starting from where the Pierre Shale meets the Ogallala Group.

No Cross-Section (Harlan Co.)
Added Wells: None
Wells 21018(5-23-8) and 47689(5-23-30) will remain in the alluvial boundary after being compared to two test holes (50-A-48/58-24-25 and 51-A-48/5-23-7). The level that these wells are pumping seems to be above the top of the Ogallala. However, most of the alluvial boundary surrounding and upstream of these wells will be removed.

No Cross-Section (Gosper & Furnas Co.)
Added Wells: None
Checked wells 23128(6-21-19), 30903(6-21-19) and 110812(5-22-25) in Gosper County and 62018(4-22-12) in Furnas County to see if they are

pumping water from the alluvium or Ogallala material. Upon comparing the well data of these wells to three test holes (45-B-48/7-21-18, 46-B-48/6-21-7, 47-B-48/6-21-19) that roughly parallel the tributary where these wells are located, I found that the Ogallala is deeper than the pumping depth to each of these three wells.

Sheet P (Furnas Co.)
Added Wells: None
Wells 113495(4-21-12) and 113496(4-21-12) were compared to the nearest test hole (32-A-48/5-20-31) in the southwest corner of Phelps County (about 6000 to 7000 feet north of the wells). Near the mouth of the tributary, I compared the nearest test hole (17-U-41/4-21-24) in Furnas County to well 139462 (4-20-31 in Harlan County), which is found only in the **Rep_Reg_Wells.shp** file. According to the well information the pumping depth of these wells lies below or within lime and sandstone material associated with the Ogallala material. The boundary along this tributary will be removed.
Wells 79811(4-21-8), 38034(4-21-9) 48948(4-21-4) all pump water from sediments that appear to be in the Ogallala. There is some confusion about well 61171(4-21-16 or 4-21-17); two different legal descriptions are given along with two different locations in each well file. Two additional wells (124552 and 62940, both in 4-21-16 and located in the **Rep_Reg_Wells.shp** file only) also seem to be pumping water from the Ogallala material. It cannot be determined as easily for well 62940, but well 124552 pumps water from sand & gravel that also have clay and lime. Both have pumping levels of over 100 feet deep. This tributary will also be removed.
Wells 114060(4-21-2) and 112911(4-21-2) are also, according to the well information, pumping water from Ogallala Material. The tributary will also be removed.

No Cross-Section (Furnas Co.)
Added Wells: None
Wells 98650(5-21-34) and 67263(5-21-26, **Rep_Reg_Wells.shp** file only) also pump water from the Ogallala according to the well information. The tributary will be removed.

No Cross-Section (Gosper Co.)
Added Wells: None
Well 110812(5-22-25) appears to be drawing water from the Ogallala. When compared to test hole 47-A-48 (5-22-25, same section to the southeast) the pumping depth is well below the top of the Ogallala and also below cemented sand (according to the well log). This tributary will be removed.

No Cross-Section (Furnas Co.)
Added Wells: None
Well 115271(4-22-5) appears to be drawing water from the Ogallala. When compared to test hole 38-B-47 (5-22-33, less than 9500 feet to the north) the pumping depth is well below the top of the Ogallala and also below sandstone (according to the well log). This tributary will also be removed.

No Cross-Section (Frontier Co.)
Added Wells: None
Well 45406(6-26-25) is pumping water from sand and sandstone that is probably from the Ogallala (according to the well log). Well 23112

(5-25-3) is not as clear, according to the well information, it is pumping water from clay 30 feet below the surface. Test hole 58-A-48 (5-25-9, less than a mile to the west and a little south) suggests the top of the Ogallala is about 38 feet below the surface. Well 23112 is not located in the **Wells.shp** file, so placement of the alluvial boundary is not dependent on this well. So the tributary will be removed at the boundary between the Ogallala and Pierre Shale.

Sheet Q (Furnas Co.)
Added Wells: None
Wells 71698(3-24-2) and 62256(4-24-27) both pump water from layers that underlie limestone or sandstone. Sand & gravel below these rock layers suggests that the water originates from the Ogallala Group. Wells 78508(2-25-26) and 78509(2-25-23) do not correlate well with well 37520(2-25-26), located within the old alluvial boundary) and they also pump water from layers of gravel and other sediments below limestone and/or sandstone. The presence of these sediments below the rock layers suggests that water is being pumped from out of the Ogallala. None of these wells (except for well 37520, which is already within the alluvial boundary) will be included.

Sheet R (Furnas Co.)
Added Wells: 94227(2-23-11)
Well 94227(2-23-11) almost appears to be made up entirely of alluvium but there is no pumping level in the well information. A nearby well (94226/2-23-11 **Rep_Reg_Wells.shp** file only) has a similar lithology and water is being drawn from a layer of sand & gravel that has traces of clay and lime. There is not limestone or sandstone to suggest that water is being drawn from the Ogallala Group, so these wells will be included in the alluvial boundary.
Well 71433(1-21-5) is pumping water from a layer of sand and gravel with limestone ledges. According to the well placement in the **Rep_Reg_Wells.shp** file in comparison to the bedrock geology map puts the location right near the border between the Ogallala Group and the Niobrara (Chalk) Formation. In the **Wells.shp** file the well is located in the Ogallala, but I have found many of the well placements from that file to be suspect. The placement of gravel within the limestone suggests that the water is being pumped from the Ogallala, so the well will be left out of the alluvial boundary.
Well 51106(2-22-20) was compared to well 39735(2-22-21), which is located within the old alluvial boundary. Water us pumped from gravel in well 51106 that is located below clay and limestone. Well 39735 is made up only of 58 feet of clay overlying gravel, no limestone. This suggests that water in well 51106 is being drawn from the Ogallala, so it will not be included in the alluvial boundary.

No Cross-Section (Furnas Co.)
Added Wells: None
Farther to the north, well 465849(4-22-15) will not be included because water is being drawn from gravel that lies below sandstone. This suggests that the water is being pumped from the Ogallala.

No Cross-Section (Red Willow Co.)
Added Wells: None from **Wells.shp**, 62295(3-29-13) in **Rep_Reg_Wells.shp**
Adjustment to include bottomland around 3-28-18 and 3-29-12&13. No wells from the **Wells.shp** file were included, but some wells from the **Rep_Reg_Wells.shp** file are included. One well (62295) is in the

Ogallala, but draws water from a shallow sand & gravel layer that correlates well with a layer of sand & gravel that occurs in a nearby well 42693(3-28-18) in the Pierre Shale that appears to be alluvium.

No Cross-Section (Lincoln & Frontier Co.)
Added Wells: None
Wells upstream from well 33833(7-27-18) all draw water from layers of sediment that either includes sandstone or is below sandstone, thus all of the wells in this area most likely are pumping water from the Ogallala. So the tributary above the border between the Ogallala and Niobrara (Chalk) Formation will be removed.

No Cross-Section (Frontier Co.)
Added Wells: None
Well 75891 was removed as water is pumped from below a layer of limestone, which suggests it is from the Ogallala.
The alluvial boundary was scaled back on the other (west) side of the tributary. Wells 101543(6-27-13), 101544(6-27-24), and 30043(6-27-24) all appear to pump water out of the Ogallala. Well 30042(6-26-19) contains mostly sand & gravel and may draw water from alluvium. It is the only well to be included.
To the southeast (back on the east side of the tributary) wells 78132(6-26-21), 67663(6-26-28), 105201(6-26-28) and 71143(6-26-28) will be included since water is not being pumped from materials associated with the Ogallala in any of these wells.

No Cross-Section (Hayes Co.)
Added Wells: None
The tributary upstream from the border between the Ogallala and the Pierre Shale was removed. In well 20685(6-31-35) water is drawn from sand & gravel underlying "rock" according to the well data. Another well (64766/6-31-26) draws water from sediments below sandstone. The lithology in these wells suggests the water comes from the Ogallala.

No Cross-Section (Hitchcock Co.)
Added Wells: None
The tributary upstream from the border between the Ogallala and the Pierre Shale was removed. Wells in this area including 19920(4-31-7) and 49013(4-31-7) draw water from sediments below sandstone, which suggests it is being pumped from the Ogallala.

No Cross-Section (Hayes and Chase Co.)
Added Wells: None
There are two tributaries in Hayes County that stretch into Chase County. Several wells, including 72494(5-34-19), 41687(5-34-19), and 37025(5-35-24) draw water from sediments below sandstone layers that are associated with the Ogallala.

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List of DRGs in the Republican River Basin:

DRGs as mentioned earlier are digital raster graphics or digital topographic maps (1:24000 scale) from the US Geological Survey. The maps listed below are only the topographic/quadrangle maps that include some of the area covered by the original alluvial map. Not all of these were used in this study, but are included in this memo for future reference. The numbers associated with each DRG (i.e. 40097a7) refers to the latitude and longitude of the map (for the example given: 97 degrees latitude and 40 degrees longitude). The following letter and number refer to a location grid with "a" being at the bottom, and numbers that increase from east to west. The DRGs are located on the Department of Natural Resources local network (located in Dnrsql/DNR_GIS/everyone/GIS/24k/DRG). On the network the DRGs are listed by number (40097b8) instead of by name. Included with the data is a shapefile with the name and location of all the quadrangles in Nebraska (Ne_quads.shp).

40097a7 (Byron/Nuckolls)
40097a8 (Hardy/Nuckolls)
40098a1 (Superior/Nuckolls)
40098a2 (Bostwick/Nuckolls)
40098a3 (Guide Rock/Webster-Nuckolls)
40098a4 (Amboy/Webster)
40098a5 (Red Cloud/Webster)
40098a6 (Invale/Franklin-Webster)
40098a7 (Riverton/Franklin)
40098a8 (Franklin/Franklin)
40098b1 (Nelson/Nuckolls)
40098b2 (Mont Clare/Nuckolls)
40098b3 (Guide Rock NE/Webster-Nuckolls)
40098b4 (Cowles/Webster)
40098b5 (Red Cloud NE/Webster)
40098b6 (Red Cloud NW/Franklin-Webster)
40098b7 (Franklin NE/Franklin)
40098b8 (Macon/Franklin)
40098c3 (Lawrence/Webster)
40098c4 (Blue Hill/Webster)
40098c5 (Bladen/Webster)
40098c7 (Upland SE/Franklin)
40099a1 (Bloomington/Franklin)
40099a2 (Republican City/Harlan-Franklin)
40099a3 (Alma/Harlan)
40099a4 (Alma SW/Harlan)
40099a5 (Stamford SE/Harlan)
40099a6 (Precept/Furnas-Harlan)
40099a7 (Beaver City SE/Furnas)
40099a8 (Beaver City SW/Furnas)

40099b1 (Republican City NE/Harlan-Franklin)
40099b2 (Republican City NW/Harlan-Franklin)
40099b3 (Huntley/Harlan)
40099b4 (Orleans/Harlan)
40099b5 (Stamford/Harlan)
40099b6 (Hollinger/Furnas-Harlan)
40099b7 (Beaver City/Furnas)
40099b8 (Hendley/Furnas)
40099c3 (Ragan/Harlan)
40099c4 (Atlanta/Harlan)
40099c5 (Mascot/Harlan)
40099c6 (Oxford/Gosper-Phelps-Furnas-Harlan)
40099c7 (Edison/ Gosper-Furnas)
40099c8 (Arapahoe/ Gosper-Furnas)
40099d5 (Loomis/Phelps)
40099d6 (Oxford NW/Gosper)
40099d7 (Arapahoe NE/Gosper)
40099d8 (Arapahoe NW/Frontier-Gosper)
40099e8 (Elwood SW/Frontier-Gosper)
40100a1 (Wilsonville/Furnas)
40100a2 (Shippee/Red Willow-Furnas)
40100a3 (Lebanon/Red Willow)
40100a4 (Danbury/Red Willow)
40101c5 (McCook SE/Red Willow)
40100a6 (McCook SW/Red Willow)
40100a7 (Culbertson SE/Hitchcock-Red Willow)
40100a8 (Culbertson SW/Hitchcock-Red Willow)
40100b1 (Wilsonville NE/Furnas)
40100b2 (Wilsonville NW/Frontier-Furnas)
40100b3 (Danbury NE/Red Willow)
40100b4 (Indianola/Red Willow)
40100b5 (McCook East/Red Willow)
40100b6 (McCook West/Red Willow)
40100b7 (Culbertson/Hitchcock-Red Willow)
40100b8 (Culbertson NW/Hitchcock)
40100c1 (Holbrook/Frontier-Gosper-Furnas)
40100c2 (Cambridge/Frontier-Red Willow-Furnas)
40100c3 (Bartley/Frontier-Red Willow)
40100c4 (Bartley SW/Frontier-Red Willow)
40100c5 (Quick SE/Frontier-Red Willow)
40100c6 (Red Willow Dam/Frontier-Hitchcock-Red Willow)
40100c7 (Burger Canyon SE/Hayes-Frontier-Hitchcock-Red Willow)
40100c8 (Beverly/Hayes-Hitchcock)
40100d1 (Cambridge NE/Frontier-Gosper)
40100d2 (Medicine Creek Dam/Frontier)
40100d3 (Freedom/Frontier)
40100d4 (Bartley NW /Frontier)
40100e1 (Eustis SE/Frontier)
40100e2 (Eustis SW/Frontier)
40100e3 (Stockville SE/Frontier)
40100e4 (Stockville/Frontier)
40100e5 (Curtis SE/Frontier)* may remove if no room
40100e8 (Camp Hayes Lake/Hayes)
40100f5 (Curtis/Lincoln-Frontier)
40100f6 (Curtis SW/Lincoln-Frontier)
40100f8 (Suttlers Canyon East/Lincoln-Hayes)
40100g5 (Wellfleet SE/Lincoln)

40100g6 (Wellfleet/Lincoln)
40100g7 (Somerset/Lincoln)
40100g8 (Dickens/Lincoln)
40101a1 (Trenton SE/Hitchcock)
40101a2 (Trenton SW/Hitchcock)
40101a3 (Max SE/Dundy-Hitchcock)
40101a4 (Max/Dundy)
40101a5 (Benkelman/Dundy)
40101a6 (Parks/Dundy)
40101a7 (Rock Creek Lake/Dundy)
40101a8 (Haigler/Dundy)
40101b1 (Trenton/Hitchcock)
40101b2 (Stratton/Hitchcock)
40101b3 (Max NE/Dundy-Hitchcock)
40101b4 (Rock Canyon/Dundy)
40101b5 (Arrow Head Lake/Dundy)
40101b7 (Haigler NE/Dundy)
40101c1 (Palisade/Hayes-Hitchcock)
40101c2 (Palisade SW/Hayes-Hitchcock)
40101d1 (Palisade NE/Hayes)
40101d2 (Hamlet/Hayes)
40101d3 (Wauneta East/Chase-Hayes)
40101d4 (Wauneta West/Chase)
40101d5 (Enders/Chase)
40101d6 (Champion/Chase)
40101d7 (Reservoir Lake/Chase)
40101e1 (Hayes Center/Hayes)
40101e3 (Dittons Creek SE/Chase-Hayes)
40101e4 (Dittons Creek/Chase)
40101e5 (Imperial Muni Airport/Chase)
40101e6 (Imperial/Chase)
40101e7 (Chase/Chase)
40101e8 (Lamar/Chase)
40100f1 (Suttlers Canyon West/Lincoln-Hayes)
40101f4 (Dittons Creek NW/Perkins-Chase)
40101g1 (Melton Ranch Airport/Lincoln)
40101g2 (Wallace/Lincoln)
40101g4 (Elsie/Perkins)

Shapefiles associated with the editing of the alluvial boundary map:

All of the following data were used in the editing process. The shapefiles appear below in roughly the same order that they appear in the "table of contents" in ArcView and ArcMap.

Nebraska_bnd.shp
New_Alluvial.shp
Alluvial.shp
Wells.shp
Rep_Reg_Wells.shp
Test_hole.shp
Repub_counties.shp
Repub_town_range.shp
Soilscdp.shp
Tmcov.shp
3percent.shp
Bedrock.shp

Perkins.shp, Chase.shp, Dundy.shp, Lincoln.shp, Hayes.shp, Hitchcock.shp, Frontier.shp, Red_willow.shp, Gosper.shp, Furnas.shp, Phelps.shp, Harlan.shp, Franklin.shp, Webster.shp, Nuckolls.shp
Ne_quads.shp
Ne_Counties.shp
Wells_00.shp

Data Storage:

Copies of all the shapefiles, memos and ArcView/ArcMap files associated with this project that are stored on disk. All were used in editing the maps except for **Ne_quads.shp** that is included for reference to the DRGs only, **Wells_00.shp** that includes all of the registered wells in Nebraska as of 1995 and **Rivers.shp** that shows the rivers of Nebraska. The only data not included were the DRGs, storing them on disk with the shapefiles was unnecessary since they can easily be accessed from the network and the large size of the DRGs made disk storage impractical.

Nebraska_bnd.shp (Nebraska state boundary)
New_Alluvial.shp (new alluvial boundary, edited version)
Alluvial.shp (alluvial boundary, original version)
Wells.shp (irrigation wells, Republican River basin)
Rep_Reg_Wells.shp (1995 registered wells in Republican basin)
Test_hole.shp (test hole location map from the UNL-CSD)
Repub_counties.shp (counties in the Republican River basin)
Repub_town_range.shp (township/range lines in the Republican basin)
Soilscdp.shp (terrace/bottomland soils in the Republican River basin)
Tmcov.shp (thematic mapper data/30 meter multi-spectral satellite imagery the Republican River basin)
3percent.shp (3% slopes in the Republican River basin)
Bedrock.shp (bedrock geology map of Nebraska from the UNL-CSD)
Perkins.shp (Perkin County section lines)
Chase.shp (Chase County section lines)
Dundy.shp (Dundy County section lines)
Lincoln.shp (Lincoln County section lines)
Hayes.shp (Hayes County section lines)
Hitchcock.shp (Hitchcock County section lines)
Frontier.shp (Frontier County section lines)
Red_willow.shp (Red Willow County section lines)
Gosper.shp (Gosper County section lines)
Furnas.shp (Furnas County section lines)
Phelps.shp (Phelps County section lines)
Harlan.shp (Harlan County section lines)
Franklin.shp (Franklin County section lines)
Webster.shp (Webster County section lines)
Nuckolls.shp (Nuckolls County section lines)
Ne_quads.shp (location of all Nebraska topographic quadrangle maps)
Wells_00.shp (registered wells in Nebraska as of 1995)
Rivers.shp (Nebraska rivers)
Ne_Counties.shp (Nebraska counties)
Republicanalluvium.apr (ArcView alluvium project file)
RepublicanRiver_Alluvium.mxd (ArcMap alluvium map file)
Republican_Alluvium.rtl (plot file to print on HP plotters)
Updating the Alluvial Boundaries - Memo.doc (project documentation)