

**BEFORE THE OKLAHOMA WATER RESOURCES BOARD
STATE OF OKLAHOMA**

IN THE MATTER of an Update to the
Maximum Annual Yield for the Alluvium and
Terrace Deposits of the Beaver-North Canadian
River underlying parts of Harper, Woodward,
Major, Dewey, and Blaine Counties, Oklahoma,
covering all or parts of Township 19N, Ranges
12WIM, 13WIM, 14WIM, 15WIM, and
16WIM, and Township 20N, Ranges 12WIM,
13WIM, 14WIM, 15WIM, 16WIM, 17WIM,
and 18WIM, and Township 21N, Ranges
14WIM, 15WIM, 16WIM, 17WIM, 18WIM,
and 19WIM, and Township 22N, Ranges
17WIM, 18WIM, and 19WIM, and 22 WIM,
and Township 23N, Ranges 18WIM, 19WIM,
20WIM, 21WIM, and 22WIM, and Township
24N, Ranges 18WIM, 19WIM, 20WIM,
21WIM, 22WIM, 23WIM, and 24WIM, and
Township 25N, Ranges 19WIM, 20WIM,
21WIM, 22WIM, 23WIM, 24WIM, 25WIM,
and 26WIM, and Township 26N, Ranges
23WIM, 24WIM, 25WIM, and 26WIM, and
Township 27N, Ranges 24WIM, 25WIM, and
26WIM, and Township 28N, Ranges 24WIM,
25WIM, and 26WIM.

**TENTATIVE ORDER FOR THE UPDATE OF THE MAXIMUM ANNUAL YIELD
FOR THE ALLUVIUM AND TERRACE DEPOSITS
OF THE BEAVER-NORTH CANADIAN RIVER, REACH I**

On this 15th day of July 2025, there came for consideration a proposed order to update the maximum annual yield for the alluvium and terrace deposits of the Beaver-North Canadian River Groundwater Basin (Reach I). Based on the updated hydrologic surveys and investigations, the Oklahoma Water Resources Board ("Board") makes and enters the following tentative findings, tentative conclusions of law, and order and directives.

EXISTING MAXIMUM ANNUAL YIELD

1. On August 9, 1983, the Board issued an Order establishing the maximum annual yield for the alluvium and terrace deposits of the Beaver-North Canadian River Groundwater Basin in Harper, Woodward, Major, Dewey, and Blaine Counties, Oklahoma, covering all or parts of Township 18N, Ranges 12WIM, 13WIM, and 14WIM; Township 19N, Ranges 12WIM, 13WIM, 14WIM, 15WIM, 16WIM, and 17WIM; Township 20N, Ranges 12WIM, 13WIM, 14WIM, 15WIM, 16WIM, 17WIM, and 18WIM; Township 21N, Ranges 14WIM, 15WIM, 16WIM, 17WIM, 18WIM, and 19WIM; Township 22N, Ranges 17WIM, 18WIM, 19WIM, 20WIM,

21WIM, and 22WIM; Township 23N, Ranges 17WIM, 18WIM, 19WIM, 20WIM, 21WIM, 22WIM, and 23WIM; Township 24N, Ranges 18WIM, 19WIM, 20WIM, 21WIM, 22WIM, 23WIM, and 24WIM; Township 25N, Ranges 19WIM, 20WIM, 21WIM, 22WIM, 23WIM, 24WIM, 25WIM, and 26WIM; Township 26N, Ranges 23WIM, 24WIM, 25WIM, and 26WIM; Township 27N, Ranges 24WIM, 25WIM, and 26WIM; and Township 28N, Ranges 24WIM, 25WIM, and 26WIM.

2. In the Order, the Board determined:
 - a. The total land area overlying the basin was 426,000 acres;
 - b. The amount of water in storage as of July 1, 1973, was approximately 4.11 million acre-feet;
 - c. The rate of natural recharge to the basin was 2.5 inches per year and total discharge from the basin during the 20-year simulation period was 6.23 million acre-feet;
 - d. Transmissivity of the basin sediments ranged from 5 to 8,030 feet squared per day and averaged 1,820 feet squared per day; and
 - e. Pollution to the basin from natural sources was considered negligible.
3. The Order determined the maximum annual yield, based on a 20-year basin life, to be one (1) acre-foot per year of fresh groundwater.

TENTATIVE FINDINGS

4. The Board has made or caused to be made hydrologic surveys and investigations of the Beaver-North Canadian River Alluvium and Terrace Groundwater Basin (Reach I), in parts of Harper, Major, Woodward, Dewey and Blaine counties. The study area is a long, narrow surficial aquifer that resides along an approximate 162-mile-long stretch of the Beaver and North Canadian rivers from the county line delineating Beaver and Harper counties to the Canton Lake in northwestern Blaine County.

The hydrologic surveys and investigations reviewed for this order include the U.S. Geological Survey (USGS) Scientific Investigations Report 2015-5183, Hydrogeological Framework, Numerical Simulation of Groundwater Flow, and Effects of Projected Water Use and Drought for the Beaver-North Canadian River Alluvial Aquifer, Northwestern Oklahoma, by Ryter, D.W., and Correll, J.S. (2015) and U.S. Geological Survey Open-File Report 81-483, Geohydrology and numerical simulation of the alluvium and terrace aquifer along the Beaver-North Canadian River from the Panhandle to Canton Lake, northwestern Oklahoma, by Davis, R.E., and Christenson, S.C., (1981).

5. The Beaver-North Canadian River (BNCR) Alluvium and Terrace Groundwater Basin is composed of unconsolidated alluvial and terrace deposits (principally sand, silt, clay, and gravel) which unconformably overlie bedrock units ranging in age from Permian to Tertiary. In most places the alluvium and terrace deposits are underlain by relatively impermeable shales (red beds) and fine-grained sandstones. However, in the northwestern region of Harper County, the alluvium and terrace deposits are hydrologically connected with the underlying Ogallala Formation. In this area, the Ogallala Formation deposits are considered part of the BNCR groundwater basin.

6. Groundwater wells completed in the alluvium and terrace deposits typically yield 100-300 gallons per minute, with a mean of 105 gallons per minute. Individual well yields range from less than 10 gallons per minute to more than 1,000 gallons per minute in some high-capacity irrigation and municipal wells. Wells completed in the Ogallala Formation deposits average 50 to 65 gallons per minute. Groundwater is predominately used for irrigation purposes, with a smaller proportion used for public supply and power.

7. The total land area overlying Reach I of the basin is approximately 853 square miles or 545,863 acres (excluding the areas of Lake Canton and Fort Supply Lake) based on updated Oklahoma Geologic Survey surficial geology maps, drillers logs submitted to the OWRB, and aerial photography (see *Executive Summary Report* for details of the changes to the basin area).

8. The amount of groundwater in storage in Reach I is approximately 3.1 million acre-feet, calculated as the sum of the model cell storage values calculated by multiplying the cell area (61.8 acres), cell saturated thickness, and cell specific yield. A close approximation of the storage can be calculated by multiplying the basin area by the average specific yield (Sy) of 0.19, and the average saturated thickness of 30 feet.

9. Model calibrations for the Reach I numerical flow model yielded a mean annual recharge estimated of 143,990 acre-feet per year or about 3.15 inches per year using the 858 square mile basin area; when adjusted to the updated 853 square mile OWRB defined basin area, the mean annual recharge to the basin decreased to 143,136 acre-feet per year. Accordingly, over a 20-year period, the total amount of recharge to the groundwater basin would be approximately 2.86 million acre-feet. Mean annual recharge is less in the northwestern region of the study area than in the southeastern region. Locally, annual recharge estimates can be as high as 10.6 inches.

10. To calculate the total amount of discharge from Reach I of the basin attributable to groundwater withdrawals, the Board assumes full withdrawal of groundwater authorized by rights to use the groundwater established under state laws as they existed prior to July 1, 1973, with such rights being recognized in final orders determining prior rights to use groundwater. For Reach I, active prior rights authorize the withdrawal of 33,816.5 acre-feet per year. Current regular active permits in Reach I (as of May 2025) constitute a total authorized withdrawal of 60,524.7 acre-feet per year. The total anthropogenic discharge from the basin over 20 years is about 1.9 million acre-feet, assuming full withdrawal of the authorized groundwater use and no change in the status of the permits over the life of the basin. The cumulative total discharge from the basin during the 20-year model simulation was about 4.58 million acre-feet.

11. Model calibrated horizontal hydraulic conductivity (Kh) for Reach I ranged from 6 to 279 feet per day, with a mean of 70 feet per day. Values of transmissivity from six published aquifer tests in Woodward County showed a transmissivity range of 2,144 to 8,710 feet squared per day. Davis and Christenson (1981) estimated a mean transmissivity of 1,780 feet squared per day for the modeled basin area. Model-calibrated specific yield (Sy) ranged from 0.11 to 0.29, with a mean of 0.19.

12. In general, groundwater in the basin is calcium bicarbonate type and is considered suitable for most uses. The average concentration of total dissolved solids within Reach I is about 447.6 milligrams per liter (mg/L). Groundwater that is sourced from the alluvium of either the Beaver or North Canadian rivers generally has a higher overall concentration of total dissolved solids than the associated terrace deposits; concentrations greater than 1,000 mg/L have been measured in this aquifer historically and were characterized as either sodium chloride or calcium sulfate types. Higher concentrations of sulfate and chloride are likely sourced from dissolution of underlying Permian-age bedrock. A limited number of samples had concentrations of sulfate, manganese, iron, and chloride that exceeded EPA drinking water standards. High nitrate concentrations in groundwater are associated with areas of the aquifer overlain by croplands and are likely attributed to fertilizers; nitrate concentrations from samples collected in cropland areas were roughly 46% higher than samples collected in grassland areas.

13. From the updated hydrologic investigation and based on information in Tentative Findings Nos. 7 through 11, the maximum annual yield for Reach I of the Beaver-North Canadian Alluvium and Terrace Groundwater Basin is tentatively determined to be about 234,011 acre-feet per year, (equivalent to 4.68 million acre-feet over 20 years) with an equal proportionate share of 0.5 (acre-feet/acre)/year for the undeveloped land areas. Current active regular permits will maintain an equal proportionate share of 1.00 (acre-feet/acre)/year based on the August 1983 final order.

TENTATIVE CONCLUSIONS

14. The Board is given authority by the Oklahoma Groundwater Law, 82 O.S. Supp. 2000, Sections 1020.4, 1020.5 and 1020.6 to make hydrologic surveys and investigations, enter orders to make tentative determinations, hold hearings on the tentative determinations and make final determinations of the maximum annual yields of each groundwater basin and subbasin. The Board is also given authority to cooperate with state and federal agencies engaged in similar surveys and investigations and may accept and use the findings of such agencies.

15. The Beaver-North Canadian Alluvium and Terrace Groundwater Basin has been designated by the Board as a "major groundwater basin" as defined by the Oklahoma Groundwater Law. See Section 1020.1(3) of Title 82 of the Oklahoma Statutes.

16. According to Section 1020.5 of Title 82 of the Oklahoma Statutes, after completing hydrologic surveys, the Board is to make a tentative determination of the maximum annual yield of groundwater to be produced from a basin or subbasin based upon the following:

- a. total land area overlying the basin or subbasin;
- b. amount of water in storage in the basin or subbasin;
- c. rate of recharge to and total discharge from the basin or subbasin;
- d. transmissibility of the basin or subbasin; and
- e. possibility of the basin or subbasin from natural sources.

The maximum annual yield is to be based on a minimum basin life of 20 years from the date of the final order determining the maximum annual yield.

17. After a tentative maximum annual yield for a basin is determined, hearings are to be called and held in centrally located places within the area of the major groundwater basin. The hydrologic survey and information relied on to make the tentative order is to be made available for

all interested persons, and notice is to be provided as required by Section 1020.6 of Title 82 of the Oklahoma Statutes.

ORDER AND DIRECTIVES

IT IS THEREFORE ORDERED by the Oklahoma Water Resources Board that the updated maximum annual yield of Reach I of the Beaver-North Canadian Alluvium and Terrace Groundwater Basin as described in this Order, is 234,011 acre-feet per year and that the equal proportionate share of the yield to be allocated to each acre of undeveloped land overlying the basin is tentatively determined to be 0.5 acre-feet per acre per year. Current active regular permits will maintain an equal proportionate share of 1.00 (acre-feet/acre)/year based on the August 1983 final order.

IT IS FURTHER ORDERED that hearings be held in a centrally located place within the area of the groundwater basin, that the hydrologic survey and information relied on to establish the tentative order be made available to interested persons, and that notice of the hearings be given as required by law. After said hearings, a proposed final order shall be prepared and submitted to the Board for consideration as required by law.

IT IS FURTHER ORDERED that in conjunction with any hearings held, staff should seek input concerning any modification of the well spacing distance set forth in the current rules of 660 feet, and staff shall consider such input in drafting a proposed rule amendment for the next permanent rulemaking proceeding.

IT IS SO ORDERED by the Oklahoma Water Resources Board in regular and open meeting this 15th day of July 2025.

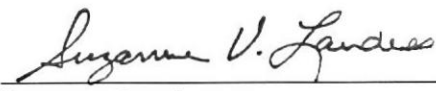
OKLAHOMA WATER RESOURCES BOARD

ATTEST:



Thomas Gorman
Chairman

7/15/2025
Date



Suzanne Landess
Secretary

7/15/2025
Date

(SEAL)



Attachment 1. Updated boundary of Reach I of the Beaver-North Canadian Alluvial Groundwater Basin with permitted lands.

