

WATER USE COMPILATION, 2005 PROJECT WORKPLAN AND TIMELINE

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Project Scope:

As part of this U.S. Geological Survey's (USGS) program to document water use on a national scale for the year 2005, USGS-Nebraska Water Science Center (NWSC) and Nebraska Department of Natural Resources (NDNR) personnel will compile estimates of water-use within Nebraska. The scope of the 2005 compilation was modified from the 2000 estimate, with a focus on preparing estimates of water withdrawals for the categories of public supply, including estimates of domestic deliveries; self-supplied domestic, industrial, and irrigation, and thermoelectric withdrawals; and thermoelectric power generation at the county level. Fresh ground-water and surface-water estimates will be prepared for all categories of use; saline ground-water and surface-water estimates will be prepared for just the categories of public supply, industrial, and thermoelectric power. If data are available, reclaimed wastewater use will be compiled for the industrial and irrigation categories. See attachment A for examples of 2005 data collection forms for all required (yellow) and optional (blue) data elements by county, and for optional elements by hydrologic unit code and aquifer.

Previous water use compilations have included estimates of water withdrawals for aquaculture, livestock, and mining. For the 2005 estimate, data for these categories will be prepared for each State using a county-based national model. Study chiefs have the option of producing independent county estimates of water withdrawals for these categories (John Lovelace, National Water Use Information Program (NWUIP), written commun., October 2006). Additional water-use categories which are optional in the 2005 estimate include: water withdrawals for commercial use; instream use, offstream withdrawals, and associated power production for hydroelectric power; wastewater-treatment water releases; reclaimed wastewater use for commercial, thermoelectric power and wastewater-treatment purposes; public-supply population served by source of supply; consumptive use; irrigation conveyance loss; deliveries from public-water suppliers to commercial, industrial, thermoelectric power users; and, number of facilities. Aggregation of water-use data by eight-digit hydrologic cataloging unit and by aquifer also is optional.

As done for previous estimates, water-use data compiled by the NWSC and NDNR will be stored in the USGS Aggregated Water-Use Data System (AWUDS). This database is a comprehensive aggregated data base designed to store both mandatory and non-mandatory data elements. AWUDS contains several routines that can be used for quality assurance and quality control of the data, and also produces tables of water-use data compiled for 1985, 1990, 1995, and 2000. County-level estimates for optional categories still may be compiled and stored in the AWUDS database, as can any optional data aggregated by hydrologic cataloging unit (described in Seaber and others, 1987) and/or aquifer (as described in Maupin and Barber, 2005).

Specific methodologies to be used for each categorical estimate generally follow guidelines prepared by the USGS-NWUIP with support from the USGS Office of Ground Water, and are described below. All methodologies will be completely documented following the data compilation, as required nationally due to State to State variability in

data availability and reliability. Documentation will be maintained by the USGS-NWSC as a reference for current data, and as a starting point for continued data collection.

Personnel and Responsibilities

The following are the primary USGS-NWSC and NDNR personnel responsible for the data generated during the compilation. Due to fiscal and personnel constraints, each agency is responsible for the county-level data generated for a given set of water-use categories (as shown below). The estimates are reviewed by personnel from the other agency prior to entry into the AWUDS.

U.S. Geological Survey Nebraska Water Science Center:

Personnel: Jill D. Frankforter (phone: 402-328-4143; email jdfrankf@usgs.gov)
Colleen Campbell (phone:402-328-4168; email cocampbell@usgs.gov)

Categories: Irrigation and thermoelectric power (once-through and closed-loop withdrawals and power generated)

Nebraska Department of Natural Resources :

Personnel: Steve Gaul (402-471-3955; e-mail: sgaul@dnr.ne.gov)
Shuhai Zheng (phone: 402-471-3959; e-mail: szheng@dnr.ne.gov)

Categories: Public-supply withdrawals, including estimates of domestic deliveries, self-supplied domestic and industry. ??? optional estimates of public-supplied commercial/industrial use, domestic use—needed for estimates for non-responding PWSs???

Specific Data Collection Methodologies

PUBLIC SUPPLY:

Sources: Computer Data Bases and Others, Nebraska Dept. of Health, Environmental Health Protection Section, public water supplier and source identification data bases.
Contact: Laura Hardesty, 402-471-0785

Source: Nebraska Department of Natural Resources Data Bank: NE Dept. of Water Resources well registration file. U.S. Department of Commerce, Bureau of the Census population files and TIGER files. Comprehensive Planning Section basic hydrologic unit database.

Source: Nebraska Department of Natural Resources Data Bank: NE Dept. of Water Resources. DNR 2005 Public Water System Survey

Source: Nebraska Department of Natural Resources Data Bank: NE Dept. of Water Resources. DNR 1995 Water Use Report and 2000 estimated values.

Method: Data base files on public water suppliers and their water sources will be obtained from the Nebraska Department of Health and Human Services (NDHHS). These files will

be queried for Public Water Suppliers (PWS) that fit the definitions of the guidelines for which adequate data were available. These PWSs will then be sent a survey questionnaire created and mailed by the NDNR regarding pumpage, deliveries, and population served for 2005. Responses will be checked, verified or clarified if needed, and data on pumpage and deliveries will be entered into a data base table by NDNR. The rate of return for previous surveys (conducted in 1995 and 2000) was greater than 66 percent. The City of Lincoln Water System and the Metropolitan Utilities District (MUD) in Omaha will be contacted by telephone, and asked to provide requested pumpage and supplemental data, which will be entered into the data base. In some cases, regression equations will be developed for per capita use rates. Average rates, or regression equations, for withdrawal; system-wide domestic, industrial, and commercial (DIC) delivery and domestic delivery will be determined. Selected use rates (for each zone previously defined by the NDHHS) will be used to estimate withdrawal and deliveries for PWSs that do not respond. Locations will be converted to latitude and longitude if necessary, and categorized by county with Arc/Info coverages. Average withdrawal per well will be calculated for each PWS and aggregated by county with the GIS location data. Surface water withdrawals will be assigned into counties based on their intakes location. When estimated, it will be assumed that surface- and ground-water served populations were proportional according to a system's totals withdrawal.

Public-Supplied Domestic withdrawals/deliveries

Estimate/compilation methodology described above.

Public-Supplied Commercial and Industrial withdrawals/deliveries:

Compilation by individual States is optional, and will not be completed as part of the Nebraska compilation.

SELF-SUPPLIED DOMESTIC WITHDRAWALS

All self-supplied domestic withdrawals will be attributed to ground water, as in previous estimates. A county's self-supplied population will be calculated as the difference between the county's total population (from the 2000 Census) and estimated Public System-Supplied Population. Self-supplied domestic withdrawals will be estimated as the product of self-supplied population and average residential delivery rate.

SELF-SUPPLIED INDUSTRIAL WITHDRAWALS

Estimates will be based on the returned Industrial Survey forms sent out previously by the NDNR, an average water use rate (gallons/employee/working/day) by major SIC was calculated in 2000 and checked by NDNR. The survey results from 1995 and 2000 Water Use compilation were also used to select average use rate for each SIC. The approximate rate of the surveys return was greater than 50 percent. These usage rates will be applied to an updates list of industries based on their SIC code. Each company's address will be used to determine the county it is located in. Self-supplied withdrawal will be estimated based on its number of employees, SIC code, and historic use rates. If a company indicated both surface and ground-water supply, the estimate will be calculated under the assumption that equal amounts of surface and ground water are being used.

THERMOELECTRIC POWER-FOSSIL FUEL (Once-Through/Closed-Loop Systems):

Background: Water withdrawal requirements at power-generation facilities depend primarily on whether or not the cooling water is recirculated. The two general types of cooling are once-through (open-loop) cooling and closed-loop (recirculation) cooling. For the 2005 compilation, water withdrawal and net power generation estimates will be compiled for each type of cooling system. Once-through cooling requires the largest amounts of water withdrawal because the water is not recirculated within the facility. The water is withdrawn from a source, circulated through the heat exchangers, and then returned to a water body at a higher temperature. This technology is common in older facilities but generally is not used for new facilities because of increasingly restrictive thermal requirements for return water. Close-looped cooling systems utilize cooling ponds and cooling towers to recirculate water within the system, thus reducing the overall water withdrawal requirement. Withdrawals to replace cooling water lost to evaporation, blowdown, drift, and leakage are considered "makeup" water. A cooling pond is a shallow reservoir with a large surface area to remove heat from circulation water. The rate of heat loss may be enhanced through the use of spray nozzles. A cooling tower is a structure designed to remove heat from water. The heated circulation water is sprayed into the tower and is cooled by radiation from the sides of the tower or contact with the cooler air. Cooling towers commonly are used where land and water are expensive, or where local regulations prohibit the release of thermal water.

Sources: The NWUIP will provide a data file with average daily water withdrawals, water releases, consumptive use, and net power generated by thermoelectric plant and cooling type and net power generated by combined heat and power plant operation (CHP) facilities, respectively, in millions of gallons per day and gigawatt-hours. The source of data for the derivative data file is the U.S. Department of Energy—Energy Information Administration (USDOE-EIA) electricity databases. USDOE-EIA maintains site-specific data for thermoelectric power and CHP plants with a nameplate rating of 10 megawatts or more. Since 2001, nuclear-power plant data have not been collected through the 'water' survey (EIA-767). However, nuclear-power plants are included in the files that have power generated (EIA-906) and the available power generated will be included in the USGS derivative data file.

Methods: Most water for thermoelectric use is self-supplied from fresh or saline surface-water sources. Smaller quantities are derived from ground-water sources or provided by public suppliers. The recommended approach for compiling data for thermoelectric power—with the exception of nuclear-fueled power plants—is to use the site-specific water-withdrawal data and power generation data from USDOE-EIA that will be provided by the NWUIP. Federally-mandated information collected and maintained by the USDOE-EIA, includes powerplant ownership, location, method of cooling, sources of water, average withdrawal rates, average discharge rates, operating status, and power generated. This information is collected from monthly and annual surveys of powerplants. Information on net power generation and energy source may be found in the EIA-920 Combined (utility, non-utility, and combined heat and power plant) database, formerly and

successively, EIA-906 and EIA-759. Beginning with January 2004 data collection, the EIA-920, has been used to collect data from the CHP plants. EIA-767, Annual Steam-Electric Plant Operation and Design Data, contains cooling water information for all natural gas, fossil, and biomass fueled plants with a generator nameplate rating of 10 or more megawatts. Average rate of water withdrawal, water release, and consumptive use to the nearest cubic foot per second by cooling system type for each generator and power plant are included in the EIA-767 database.

Water withdrawal and power-generation data for the nuclear- power plants and for the smaller plants with a generator rating of less than 10 megawatts will be collected using a different approach such as contacting the individual utility. If the contact person for a utility is not known, the person at the utility who prepares the Discharge Monitoring Reports (DMR's) for USEPA will be identified and contacted. The Nebraska Department of Environmental Quality may be an additional source of data, as it is responsible for data entered into the USEPA's Permit Compliance System (PCS) database, which was designed to track permit, compliance, and enforcement status data for the National Pollutant Discharge Elimination System (NPDES) Program under the Clean Water Act. A NPDES permit is required for all point discharges into United States waterways.

The PCS database contains descriptive information on major power-generating facilities, their location, and monthly return flows. The NPDES permit application and the permit itself usually include detailed descriptions of the plant that provide basic information on all the sources of supply for the plant, the different ways in which water is used in the plant, and water included in the reported discharge values. Power generation data may also be used to estimate thermoelectric power water withdrawals. A coefficient to estimate the gallons of water used per unit-hour of electricity generated can be calculated using information on water withdrawals and power generation from plants of similar age, design, and cooling methods. This coefficient then can be multiplied by the amount of electricity generated over a specified time period by the plant for which withdrawals are being estimated. Coefficients ideally are derived using the gross power produced, if available. Monthly net power generation, in megawatt-hours, is available in the EIA-920 database but does not include the electricity used to run the powerplant itself. The in-powerplant electricity use that can be added to the net power is available from other EIA databases, but will not be part of the NWUIP derivative data file provided to the study chiefs.

MINING AND LIVESTOCK:

Compilation of the data by NWSC personnel is optional. Due to resource limitations, efforts within Nebraska will be limited to reviewing the data compiled by John Lovelace.

IRRIGATION:

Sources: National Agricultural Statistics Service:

The following is the NASS website for the State of NE (2005 data)
http://www.nass.usda.gov/Statistics_by_State/Nebraska/index.asp.
Check on status of the NASS cropland data layer availability
(<http://www.nass.usda.gov/research/Cropland/SARS1a.htm>)

PROVISIONAL VERSION-DO NOT CIRCULATE

U.S. Department of Agriculture's Census of Agriculture, 2002: The following websites are directed toward pdf files containing estimates of irrigated acres and acres harvested by crop type. If possible electronic files of the data will be obtained and used in the estimate of irrigated acres

2002 USDA Census of Ag.-Irrigated land estimates by County located on website:
http://www.nass.usda.gov/census/census02/volume1/ne/st31_2_010_010.pdf

Selected crops harvested:

http://www.nass.usda.gov/census/census02/volume1/ne/st31_2_023_023.pdf

Grains:

http://www.nass.usda.gov/census/census02/volume1/ne/st31_2_024_024.pdf

Misc. crops:

http://www.nass.usda.gov/census/census02/volume1/ne/st31_2_025_025.pdf

Field seeds, grass seeds, hay:

http://www.nass.usda.gov/census/census02/volume1/ne/st31_2_026_027.pdf

Vegetables:

http://www.nass.usda.gov/census/census02/volume1/ne/st31_2_028_028.pdf

Berries:

http://www.nass.usda.gov/census/census02/volume1/ne/st31_2_031_032.pdf

Source: U.S. Dept. of Agriculture, Natural Resources Conservation Service, 1997 national resources inventory data base. http://www.ne.nrcs.usda.gov/technical/NE_nri.html

Source: NE Dept. of Water Resources surface water rights file. Conservation and Survey Division Center pivot inventory, 1974 - 1988, database.

Source: Nebraska Natural Resources Commission, Comprehensive Planning Section 1986 water rights data base.

Source: Nebraska Department of Water Resources, Files of tables of lands with water rights.

Source: University of Nebraska-Lincoln, High Plains Climate Center, precipitation and crop potential evapotranspiration data bases.

Source: University of Nebraska-Lincoln, Institute of Agriculture and Natural Resources, center pivot water inventory.

Source: Upper Republican Natural Resources District crop acreage and ground water pumpage data base. Contact: Heather Francis

ACRES IRRIGATED

Methods: From the NASS web site, all available data for crop acreage from 2005 will be used with the Census of Ag. Data from 2002 to estimate irrigated acres by crop. Once the data has been located it will be organized based on the amount of water consumed during growth. The four categories used historically are: 1.) high water use crops (HWRC), which include corn, silage, sugar beets, and popcorn; 2.) low water use crops (LWRC), which include dry beans, sorghum, soybeans, and sunflowers; 3.) hay, including alfalfa; and 4.) Small grains, which include wheat, barley, oats, proso millet, and rye. The acres irrigated will be estimated for each of the categories.

IRRIGATION: WITHDRAWALS

Method: Potential evapotranspiration (PET) and precipitation data will be obtained from the High Plains Climate Center from all available stations within the State for numerous crops. Data for representative crops for 4 water use categories (high water requirement, low water requirement, small grain, and hay) will be used to determine the crop irrigation requirement (PET minus Precip using daily data with a limit on effective precipitation due to infiltration capacity and runoff). The length of the growing season will be determined based on representative planting dates for all crops at all stations and will be selected from information in "Nebraska Weather & Crops." Withdrawals will be assumed to be equal to the seasonal crop irrigation requirement (CIR) for the 4 categories and adjusted with actual pumpage data when available (will contact the various NRDs and irrigation districts to determine what was pumped or released for irrigation during the drought conditions in 2005). Arc/Info will be used to locate the stations and calculate the average CIR for every category for every county.

The percentage of each county irrigated from ground water and surface water sources will be estimated from NRCS 1997 NRI data (most recent inventory available), 1985 water use data (Steele), 1995 water use data (NDNR), data from the NDNR water rights and registered wells data bases, and the center pivot data base. The percentage of surface water irrigated land supplied by irrigation districts with identifiable canals was estimated with data from the same sources. The status of data on use of micro irrigation methods in this state will be evaluated as this type of data has not been available for previous compilations. Irrigation methods efficiencies from 1985 will be evaluated and used if better efficiency data is not available.

Data will be reviewed to determine if golf-course irrigation can be quantified. If so, these fields will be populated. If not, all values will be estimated using crop irrigation, so the values for crop irrigation will equal the total values entered into AWUDS.

Data Aggregation

As most data is aggregated from county-level data sources, the site-specific water-use aggregation system (SWUDS) will not be utilized for the Nebraska compilation. County-level data will be aggregated for each category in Excel spreadsheets. All necessary calculations will be completed within the spreadsheets, such that the formulas are available for future use. When GIS coverages are utilized to calculate estimated values, the coverages and calculations used will be described in the compilation documentation

and will be available with the other electronic data files. Final totals will be transferred from the spreadsheet used for calculations or output from the GIS coverage, to a final spreadsheet for data entry into the AWUDS. The aggregation of water-use estimates from the USGS and NDNR personnel will be completed by December 1, 2006 as indicated in the timeline in Attachment B.

AWUDS Data Entry

Data generated during the Nebraska water-use compilation will be batch loaded from Excel spreadsheets to the AWUDs by Colleen Campbell (USGS-NWSC) by January 1, 2007.

Data Review

Following data entry, the data will be reviewed by utilizing quality-assurance and quality-control (QA/QC) programs within AWUDs including: checks for erroneous values, comparison of totals by area, and comparisons of data between 2 years. Data generated by the USGS will be forwarded to NDNR personnel along with output from the AWUDs QA/QC programs for review. Upon receiving NDNR approval, the data will be given to senior management within the USGS-NWSC for an additional review. Similarly, data generated by the NDNR will be run through the AWUDs QA/QC programs, with the program output and preliminary estimates reviewed by USGS-Water Use Personnel, as well as senior management from the NWSC. Local review of the data will be completed by February 1, 2007

Data Documentation

Complete documentation of the methodologies used to generate data estimates for each category will be completed prior to submitting the data for regional review (March 30, 2007).

Data Submission to Region

Any revisions to the data will be completed by February 28, 2007. The Nebraska data will be submitted to Joan Kenny for regional review prior to the March 30, 2007 deadline.

Data Submission for National Compilation

The regional review (and any necessary revisions) of the Nebraska data should be completed and the data submitted for the National compilation by September 28, 2007.

References

- Maupin, M.A., and Barber, N.L., 2005, Estimated withdrawals from principal aquifers in the United States, 2000: U.S. Geological Survey Circular 1279, 46 p.
- Seaber, P.R., Kapinos, F.P., and Knapp, G.L., 1987, Hydrologic unit maps: U.S. Geological Survey Water-Supply Paper 2294, 63 p.

Attachment A: Examples of Data Collection Forms

Attachment B: Project Timeline (FY2006 and FY2007)

TASKS	FISCAL YEAR 2006												FISCAL YEAR 2007											
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
Receive guidance document																								
Contact DNR																								
Develop work plan																								
Attend workshop																								
Retrieve National datasets																								
Contact local sources of water use data																								
Prepare documentation document-sources and methods																								
Submit USGS estimates to DNR for review																								
Retrieve DNR portion of report-estimates for review																								
Enter data into AWUDS																								
Send data for regional review																								
Respond to regional questions about data																								
Release data for National report																								
Publication of State report/website?																								