www.epa.gov

Water Supply and Demand by Watershed for the Contiguous U.S.
Elena Horvath¹, Megan Mehaffey², Anne Neale³, Doug Browning¹

¹Student Services Contractors, US EPA/ORD, Research Triangle Park, NC, USA; ²US EPA/ORD, Research Triangle Park, NC, USA

Introduction
Over 400 million gallons of water are withdrawn per day in the United States. The four sectors which account for over 90 percent of the withdrawals are: industrial, thermoelectric power, domestic, and agricultural irrigation. While water supply and demand are largely managed along governmental boundaries, its distribution within is uneven. Providing a detailed spatial evaluation at a finer resolution can help determine potential imbalances between supply and demand today and into the future.

Water Supply
A gross estimate of water supply can be determined by subtracting average annual evapotranspiration, the estimated amount of rainfall that either evaporates from the surface or is transpired by plants, from precipitation. While this type of estimation does not take into account other supply sources, such as groundwater, snow melt, or inter-basin transfers, it does provide a spatial representation of where water supply may be limited.

Water Demand - Domestic
Domestic water demand is the amount of water used for indoor and outdoor residential purposes. It includes self-supplied private wells and publicly-supplied municipalities. It includes surface and groundwater. Estimates are for primary residences only (i.e., excluding second homes and tourism rentals).

Processing Overview:
Calculated domestic water use, resulting in gallons per person per day per county. Converted to raster. Calculated median use by state for normalization. To weight population, multiplied state medians by the dasymetric data. Summarized by 12-digit HUC.

Water Demand - Agricultural
Agricultural water demand provides an estimate of the water used for irrigation. Agricultural water use, as defined in this case, meets a variety of needs before, during, and after growing seasons (e.g., dust suppression, field preparation, chemical application, weed control, salt removal, frost protection, cooling, and harvesting). Sources include self-supplied surface and groundwater, as well as public and irrigation-specific organizations.

Processing Overview:
Prepared water use data. Where available, removed golf water use. Calculated Agricultural water use per Acre per day per county. Counties with Ag per Acre greater than zero were converted to raster and evaluated. Counties with no Ag per Acre were assigned the state mean or median, whichever was closer to the majority. Converted to Ag per 30m Cell. Prepared UW remotely sensed irrigation data. Reclassified 0% to NoData. Prepared CDL-NLCD. Reclassified data to 2 potentially irrigated double crops), 1 (potentially irrigated single crops), and 0 (all others/unlikely crop irrigation). Created combined UW/CDL-NLCD (UCN) layer. Extracted from CDL-NLCD using UW as a mask (see below). Distributed and weighted water use. Multiplied the UCN by the final Ag per Cell raster. Summarized results by 12-digit HUC.

Water Demand - Thermorelectric
Thermoelectric power through steam powered turbines demands is based on water withdrawn for electrical generation, but does not account for water that is returned to the watershed after use.

Data Sources:
• 2005 County level USGS Water Use Program data
• 2008/2009 Dun and Bradstreet source data

Processing Overview:
Aggregated facility point sites. Joined facility point sites to county polygons. Created IDW raster. Assigned IDW raster value to points with no county data. Joined points to HUC12s. Summarized by 12-digit HUC.

Water Demand - Industrial
Industrial water demand includes the amount of water used for manufacturing and production of commodities. For the purposes of this metric, industrial water use includes chemical, food, paper, wood, and metal production. Industrial water comes from self-supplied surface and groundwater (e.g., private wells and reservoirs).

Data Sources:
• 2005 County level USGS Water Use Program data

Processing Overview:
Prepared and aligned rasters into inches. Summarized by watershed (12-digit HUC). Subtracted evapotranspiration from precipitation. Converted to millions of gallons.

Water Demand - Total
Total industrial, thermoelectric, domestic, agricultural water use (above) and proportion by sector (right) summarized by 12-digit HUC.

Conclusion
While the total water supply from precipitation in the United States is substantially greater than demand, the distribution is uneven. Many of the states west of the Mississippi river are vulnerable to drought and water shortages. Water consumption has steadily increased and remained high in these states with agriculture being the largest user, resulting in the depletion of groundwater and stream flow.

One option for reducing the impact from consumption is to incorporate ecosystem services into future land use planning. For example, returning natural vegetation in and around stream and groundwater recharge areas and reducing the proportion of impervious surface area within a watershed can slow runoff, decrease sediment transport, and improve recharge.

Acknowledgements
These data sets were produced by the US EPA for EnviroAtlas. The data were primarily processed using Esri ArcGIS 10.1. The poster series template was developed by Jessica Jahre. This poster was created in June 2013.

Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official agency policy. Use of trade names does not imply endorsement by the authors or US EPA.