Estimation Techniques for Industrial Water Use, In Arizona

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Introduction

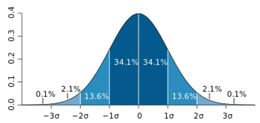
Research has shown that if changes are not made to slow the growing demand for water resources over the next century there is the potential for a water crisis within the state of Arizona. As a result, the state government created the Strategic Vision for Water Sustainability in which the Arizona Department of Water Resources (**ADWR**) has committed to expanding the monitoring and reporting of statewide water use, especially in rural areas.

Many of the rural planning regions that are outside the Basin and Range Active Management Areas (**AMA'S**) do not have regulations for water use, nor are they required to report their usage to the state. As a result, water managers must rely on interviews, past usage in AMA's, or estimates based on scientific evidence.

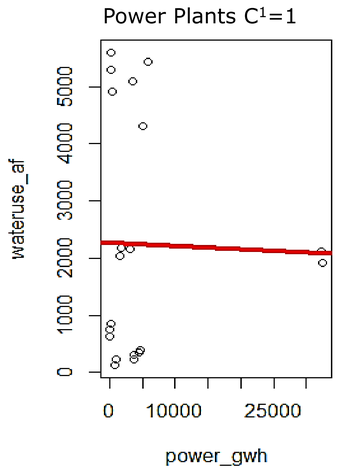
*The objective of this research is to formulate an expeditious, standardized, and accurate way to estimate industrial water use, and to create water use values (**WUV**) that are applicable on a Statewide level . Moreover, the values are to be used by water managers as they work through the 22 Planning regions within the State-* (see graphic at right).

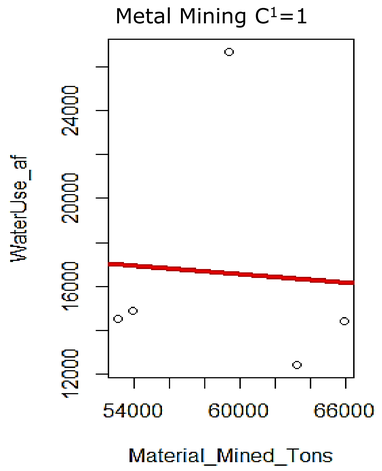
Methods

- Queried files in ADWR's in house Oracle database to gain access to industry water use reports
- Transferred data from Oracle to an Excel spreadsheet
- Imported clean Excel spreadsheets into R-Studio
- The quotient of total water use and units produced=WUV



Results





***Observation**: The regression lines and scatter plots above indicate there is a negative correlation between water use and units produced. The data has a large amount of scatter, so that makes it difficult to come up with a single best value for water use.*

INDUSTRY	UNITS	MEAN	MIN	MAX	Range/Mean	C¹
Cattle_Feedlots	gal/animal/day	21.50	17.00	30	0.7907	1
Copper_Mines	gal/lb	38.53	37.26	39.8	0.0659	1
Daries_Lactating	gal/animal/day	105.00	-	-	-	4
Daries_Non-Lact.	gal/animal/day	20.00	-	-	-	4
Egg_Production	gal/animal/yr	48.88	-	-	-	2
Greenhouses	gal/sqft/yr	182.50	-	-	-	2
LowWater_Land.	af/ac/yr	1.50	-	-	-	4
Metal_Mines	af/ton	0.28	-	-	-	1
PowerPlant	af/gwh	0.43	0.004	15.601	15.5916	1
PowerPlant_Solar	gal/mwh	25.00	-	-	-	1
RV Parks	gal/person/yr	15858.31	-	-	-	1
Sand_Gravel	gal/ton	220.57	217.90	223.24	5.3400	1
TotalWater_Surf.	af/ac/yr	5.90	5.50	6.2	0.1186	4
Turf	af/ac/yr	4.70	4.60	4.9	0.0638	4

Note: The C¹ scale (at right) is based on the quotient of the mean and the range. The resultant was then transformed from a decimal to an equal interval scale of 4-1; 4 being the most confident.

C¹ Scale	
0.000-.1975	~ 4
.1976-.3950	~ 3
.3951-.5925	~ 2
.5926-.7900	~ 1

- The above table represents the created "MEAN" value and a measure of their uncertainty(i.e., the range).
- The parameters with zero values for the "MIN", "MAX", and "Range/Mean" had only one observation, so range/mean value was not available.
- The "UNITS" are based on observations over a 1 year period.

Discussion

Uncertainties can be an vital part of understanding the quality of data used in the future water estimation and planning process. As with many scientific analyses, lack of quality data for such a specific purpose played a factor in the C¹ levels that were derived herein. One of the main factors prohibiting the progress of this project was the unavailability of a 'total units produced' portion within each Annual Report (AR).

As a future endeavor, the authors of this project recommend that all industrial water users submit a complete report on how many units they produced in any given year (e.g., power produced). This should enable more accurate data aggregation in the future. In addition to a comprehensive report, some of the WUV's that were derived for this project may need to be updated as the data for the Fourth Management Plan begins to arrive.

Conclusion

The following industrial sectors had proven WUV that were adopted from the Third Management Plan at ADWR: Turf, Total Water Surface Area, and Dairies (both lactating and non-lactating cattle); thus, the resulting C¹ levels were much higher for those sectors because the data for them have been accepted and studied. The remaining industrial sectors had either minimal data, missing data, or no data at all; thus, the resulting C¹ levels were much lower for those sectors. In order to gain higher C¹ values, planners must gather more observations for the C¹ values that are less than or equal to 2.

Overall, the data could mean many things, but two conclusions are perhaps the most adaptable 1) the sample was not large enough to produce an accurate result, or 2) the more units produced the more efficient the water use becomes.

Acknowledgements

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