This presentation premiered at WaterSmart Innovations

watersmartinnovations.com

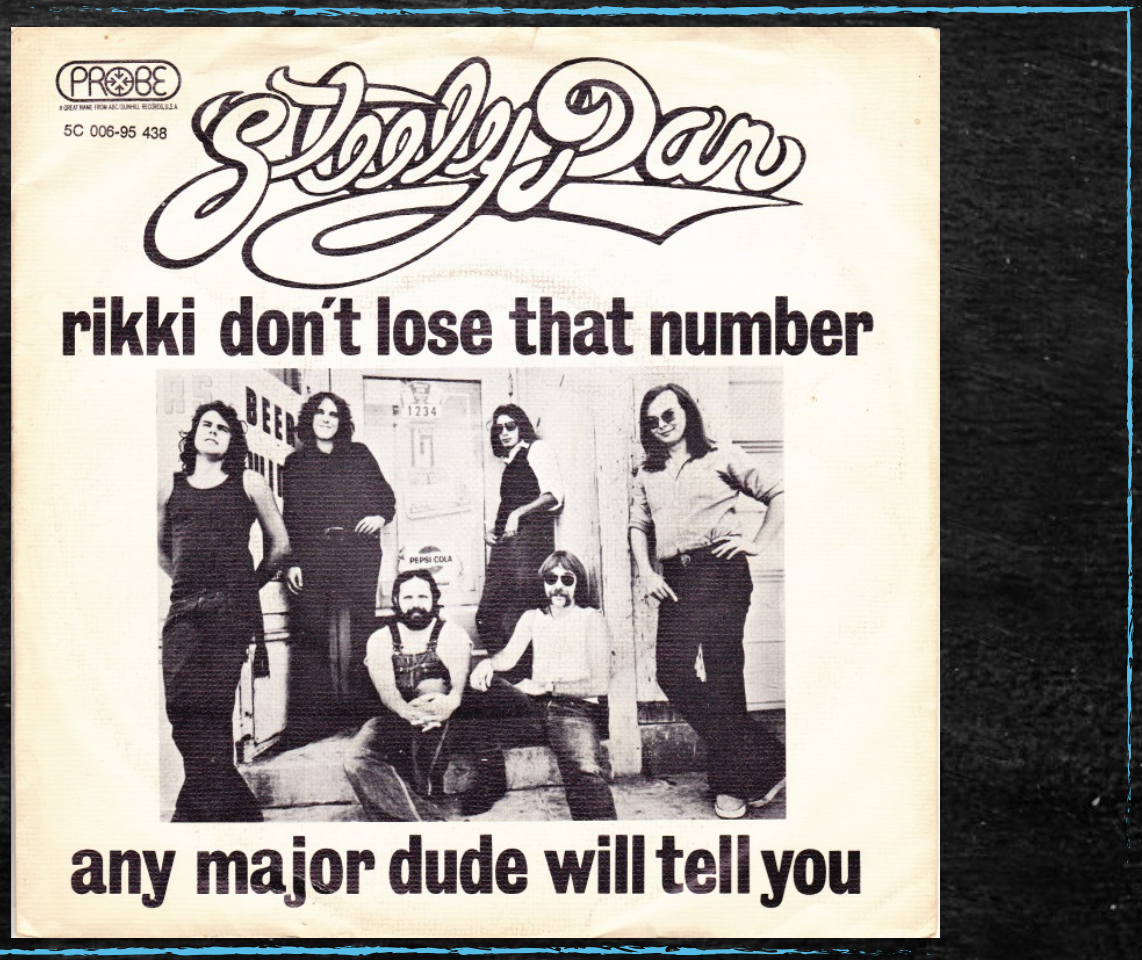
watersmart
INNOVATIONS

RICI Don’t Lose That Number

Kent Sovocool

Sr. Conservation Research Analyst

Southern Nevada Water Authority



What is the Residential Irrigation Capacity Index (RICI) and How is it used in RESNET's Water Efficiency Rating Index(WERI)?

Kent Sovocool, Southern Nevada Water Authority

RESNET (Residential Energy Services Network)

- Not-for-profit membership corporation
- Makes standards related to building efficiency
- Have existing rating and certification systems
- Have currently 11 standards
- Best known is the core Home Energy Rating Standards (HERS)
- Currently working to build Water Efficiency Rating (WER) index standard and audit and rating systems for water efficiency in partnership with the International Code Council (ICC).
- Major contributors to development include NRDC, EPA's WaterSense Program, KB Homes, and stakeholders.

Residential Irrigation Capacity Index (RICI)

- Based on state-of-the-art research examining real-world correlation between the capacity of residential irrigation systems to deliver water and water consumption.
- Successfully examined on national data set in addition to local development. Anticipated to work nationwide. In WER as an option.
- Normalized on a per unit area basis – homes with diversity of landscape sizes and configurations are treated in an apples-to-apples way.
- Does not require specialized knowledge of plant water use or taxonomy. Does not rely on variable, mutable and unadjudicated assumptions about plant water use in a given area.
- Is not a turf limitation.
- Is straightforward, and can be done by anyone. Rapidly learned and quickly done in field.

General Model for WERI Outdoor Use (developed from data made available from REUWS studies)

Equation 1:

$$\left[\frac{exp(A)}{1 + exp(A)}\right] * 1.18086 * [2.0341 * netET^{0.7154} * IrrArea^{0.6227} + 0.5756 * ind\_Pool * netET]$$

Equation 2:

$$\left[\frac{\exp(B)}{1 + \exp(B)}\right] * 1.22257 * [1.4233 + 0.6311 * \text{netET} + 0.9376 * \text{IrrArea}]$$

IF

the rated home has an automatic irrigation system

AND

Rat_Irr_Area < Ref_Irr_Area

THEN

$$Ref\_Out = equation\ 1 \Big/ \frac{equation\ 1\ (with\ Irr\_Area = \text{Rat\_Irr\_Area and both indicators} = 0)}{equation\ 1\ (with\ Irr\_Area = Ref\_Irr\_Area\ and\ both\ indicators = 0)}$$

IF

the rated home has an automatic irrigation system

AND

Rat_Irr_Area ≥ Ref_Irr_Area

THEN

Ref_Out= equation 1

IF

the rated home does not have an automatic irrigation system

THEN

Ref_Out= equation 2

Where:

Exp(A)= 1.4416 + 0.5069 X IrrArea

Exp(B)= 0.6911 + 0.00301 X netET X IrrArea

IrrArea= The size of the landscape that will receive supplemental water

Ref_Irr_Area= The size of the irrigated area in the reference home, calculate in accordance with section 3.1

Rat_Irr_Area= The size of the irrigated area in the rated home

netET= The annual historic sum of mean reference evapotranspiration minus the mean precipitation for all months that evapotranspiration exceeds precipitation

ind_Pool= Indicator representing the presence or absence of a swimming pool in the rated home

3.1 Reference Irrigated Area. Reference irrigated area shall be calculated as

If

the lot size of the rated home is < 7,000 ft²

then

$$Ref_{Irr_{Area}} = 0.002479 * lot\_area^{0.6157}$$

If

The lot size of the rated home is ≥7,000 ft²

Then

*Ref_Irr_Area = lot_area * 0.577*

Where:

Ref_Irr_Area= The size of the landscape that receives supplemental water in the reference home

Lot_Area= The size of the lot on which the rated home is being constructed

So, outdoor use is treated as a function of presence of a system, Net ET, irrigated area, and pool area. *No one on the Outdoor Subcommittee bought into this alone!*

Residential Irrigation Capacity Index (RICI)

- It was recognized that that facets of the irrigation system and the landscape certainly helps drives water consumption. Design not fully captured in the draft model. How might behavior be relevant.
- The more typical way of addressing this has been with landscape water budgets or turfgrass limitations. The group felt though in this case there were some real challenges with these:
  - The people doing the audits won't have the necessary knowledge of plant water use and site characteristics to do a budget.
  - Even if they were trained in this there really isn't time to do a budget at single-family homes.
  - Turf area provisions work but they are unpopular and putting them in will draw significant opposition.
  - Landscape plantings are also often non-standard in shape = lots of area work.
  - Sometimes the plants are one of the last things to go in. A further complication.

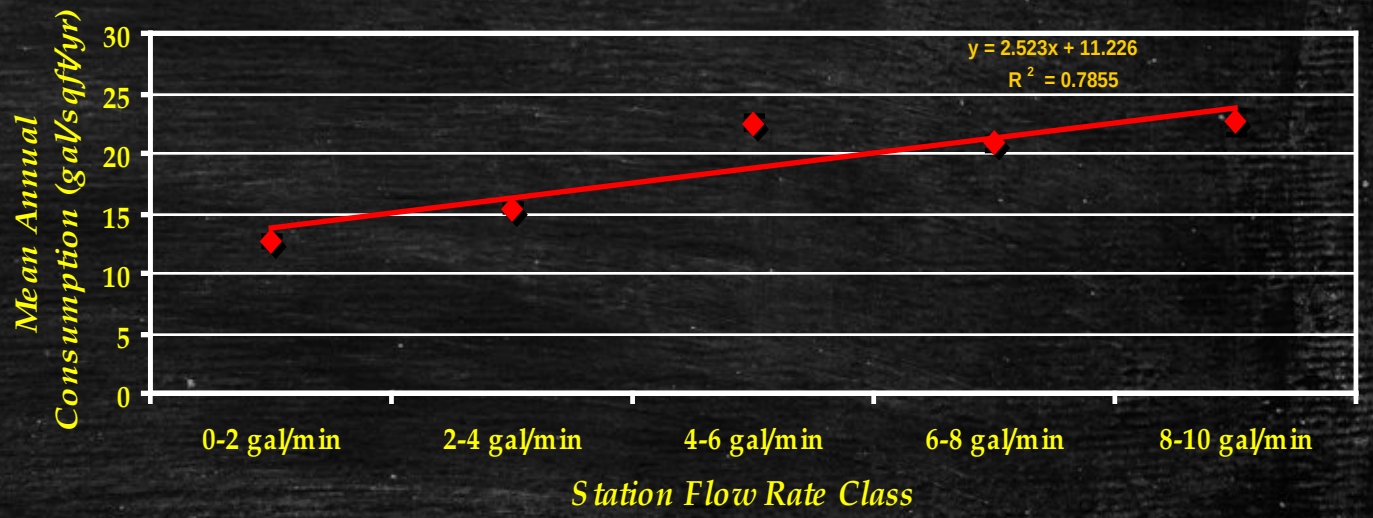
What do we do?

Started thinking how we could go about estimating use without knowledge of the plantings, but still recognize design considerations.

What if we think about the limiting capacity to use a resource . . .

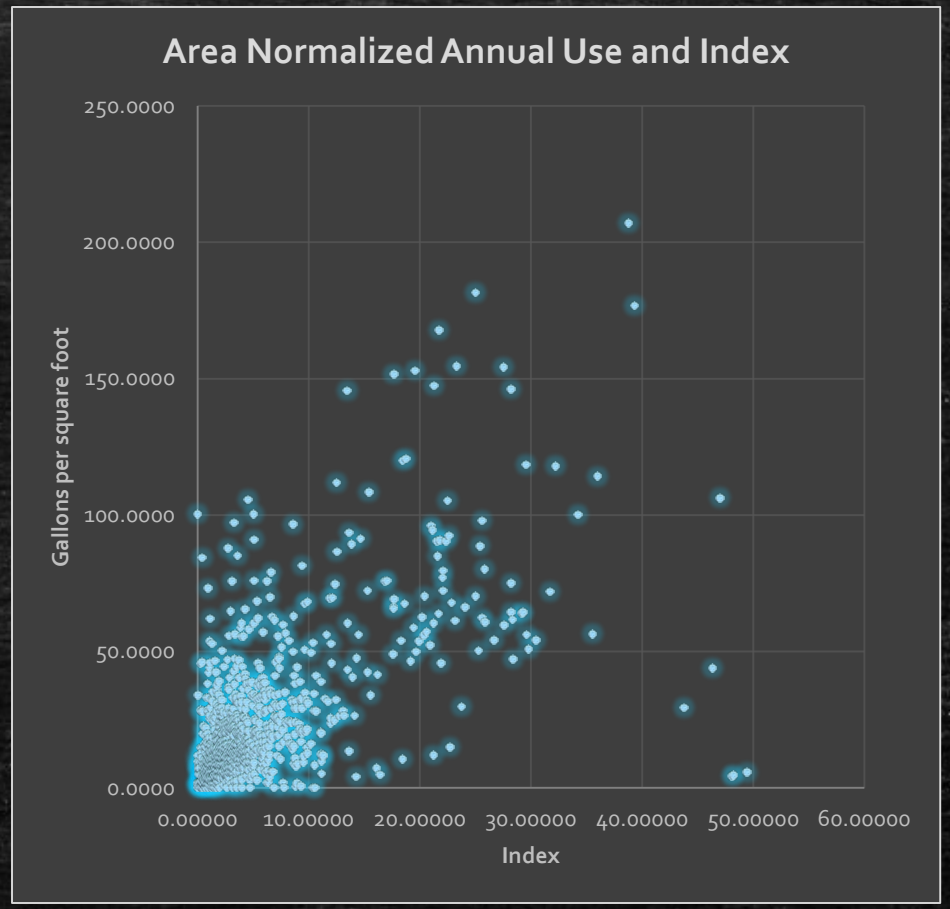
Genesis of RICI

- Back in the early 2000s, a phenomenon noted in a study in southern Nevada that had areas submetered at single-family homes.
- Correlation between the irrigation capacity and the amount of water consumed in irrigating that area.
- Interesting; effect strong enough to go into the regression model.
- Informal observation of trend over several years of analyses.



Towards using irrigation capacity . . .

- Examined relation between area normalized summation of flow rates and annual use.
- Very significant correlation results.



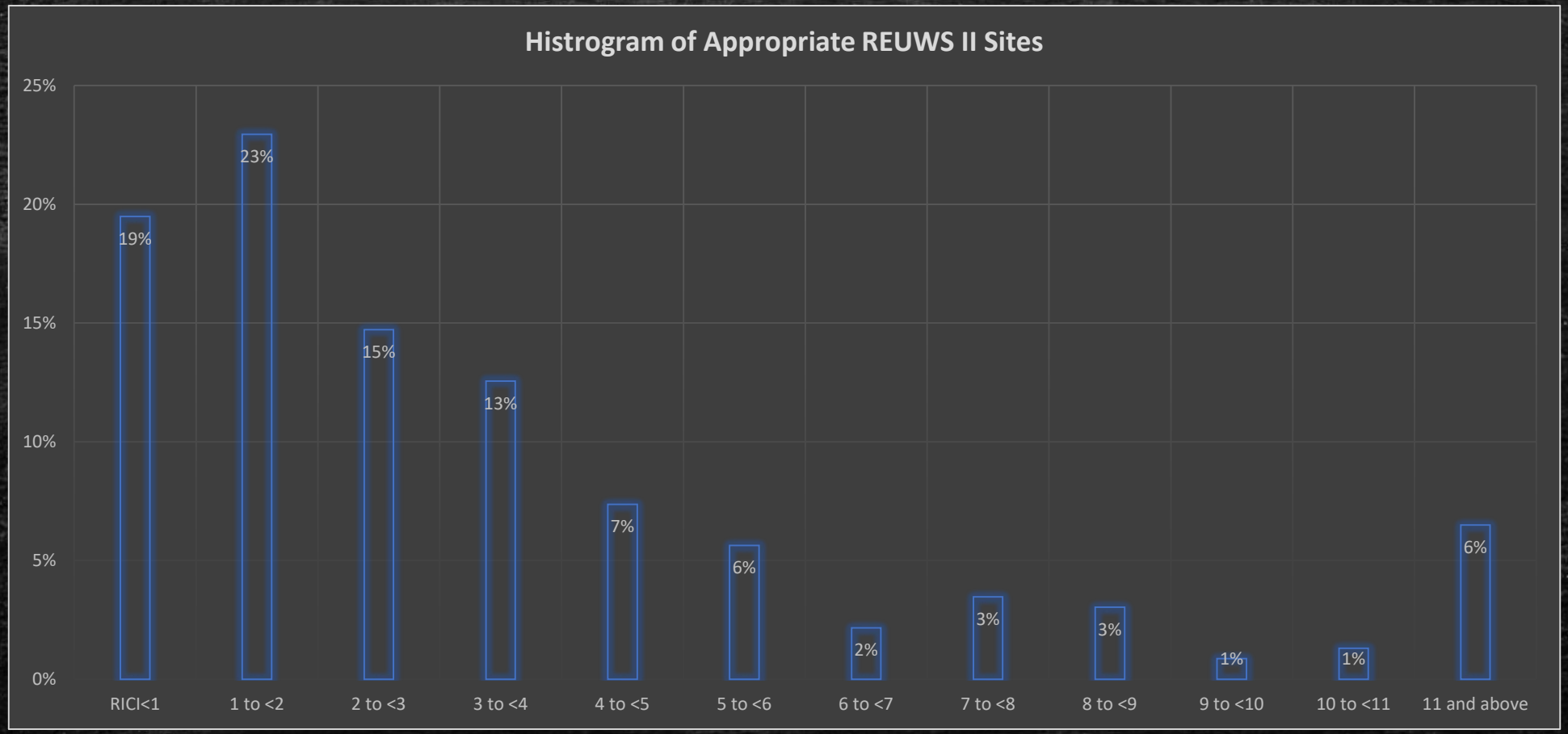
		Regression Summary for Dependent Variable: GAL_SQFT (SUMFR_AREA_INDEX)							
		R= .64025037 R²= .40992053 Adjusted R²= .40943327							
n=1213		F(1,1211)=841.27 p<0.0000 Std.Error of estimate: 19.082							
		Beta	Std.Err. of Beta	B	Std.Err. of B	t(1211)	p-level		
	Intercept			9.467905	0.687804	13.76541	0.000000		
	INDEX	0.640250	0.022074	2.424771	0.083600	29.00458	0.000000		

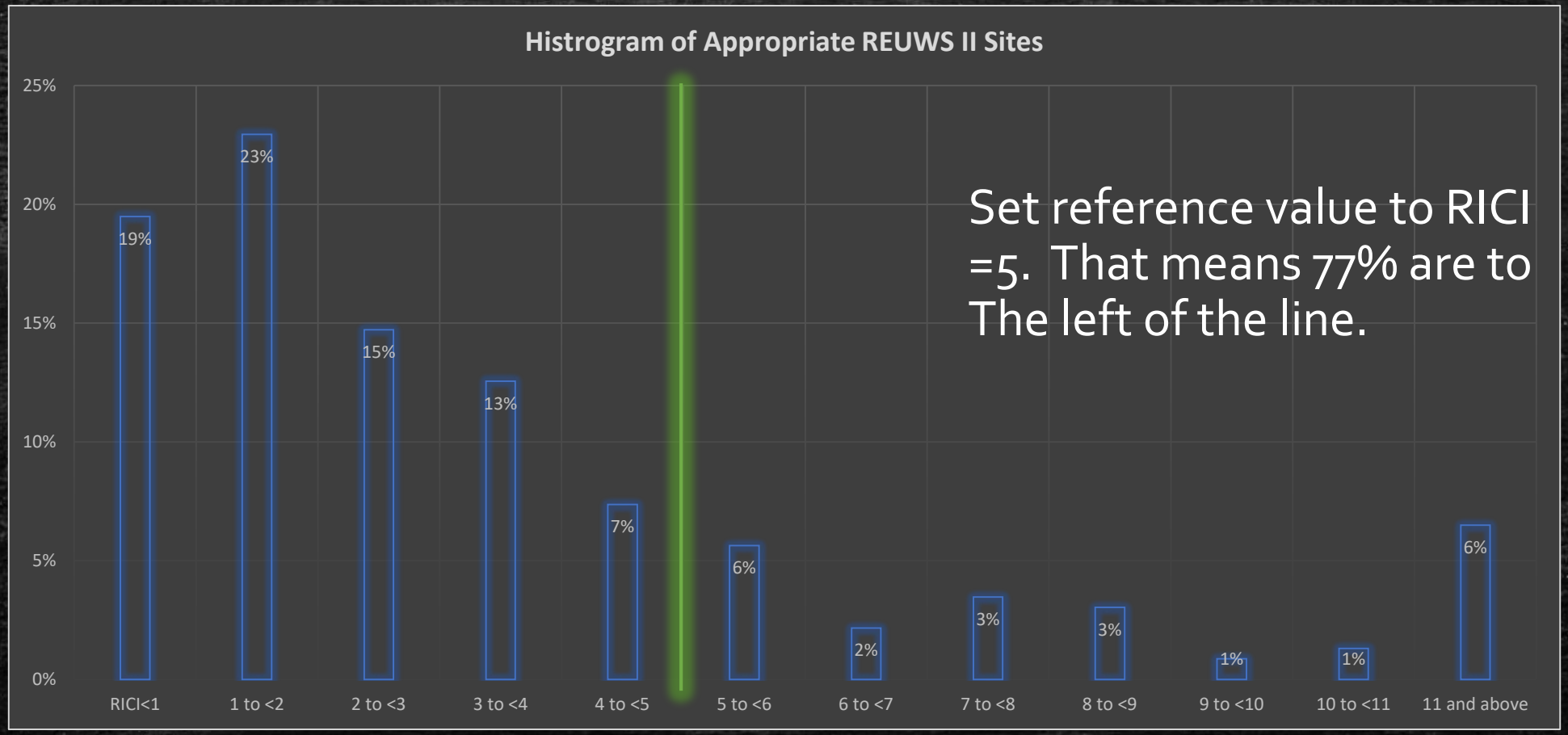
Formalized the Residential Irrigation Capacity Index (RICI) and studied more. EPA joined in this effort.

- SNWA (local dataset – landscape submeters)
  - Annual use through landscape submeters (both xeric and turf)
  - Totalized measurements of flowrate.
  - Monitored area (already measured)
  - Calculated RICI as the sum of the recorded flow rates in gallons for all monitored stations (valves)/the monitored area in square feet. Multiply this times 1000.
- EPA (national dataset: REUWS II – trace flow measures)
  - Queried homes with automated irrigation systems and events
  - Assembled flow rates (flow rates within 15% of each other assumed to be from same zone)
  - Used irrigated area values as identified for REUWS II
  - Calculated RICI as the sum of the disaggregated and quantified irrigation flow rates /the irrigated area as above. Multiply this times 1000.

Analytical similarities for Residential Irrigation Capacity Index.

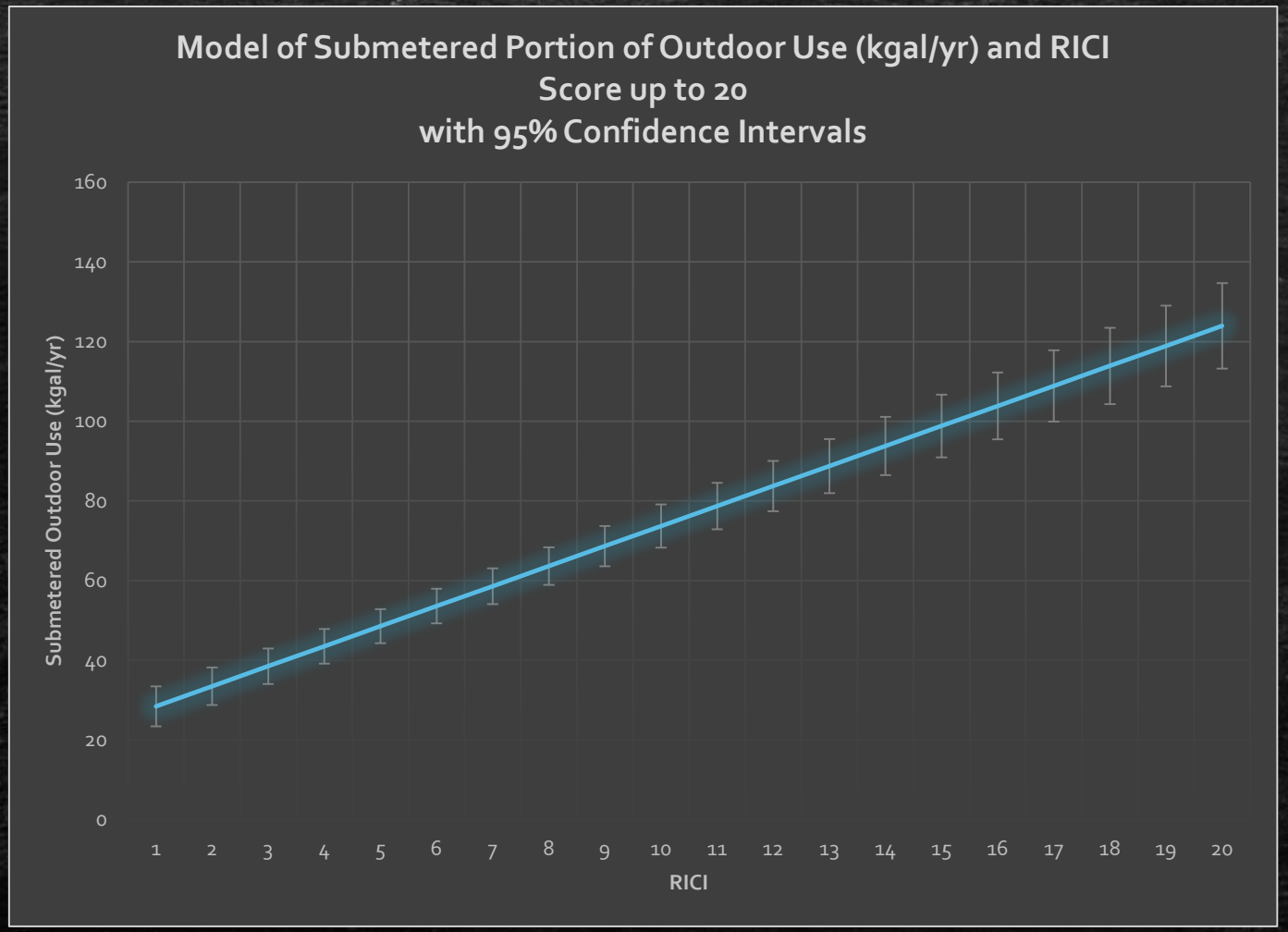
- SNWA
  - Distribution is clumped towards the low end.
  - Average RICI is 4.97
  - If this average was used for the baseline condition, 76% of the sample is below this.
- EPA (Using REUWS II data)
  - Distribution is clumped towards the low end.
  - Average RICI is 4.90
  - If this average was used for the baseline condition, 73% of the sample is below this.


Histrogram of Appropriate REUWS II Sites
25%
20%
15%
10%
5%
0%
19%
23%
15%
13%
7%
6%
2%
3%
3%
1%
1%
6%
RICI<1
1 to <2
2 to <3
3 to <4
4 to <5
5 to <6
6 to <7
7 to <8
8 to <9
9 to <10
10 to <11
11 and above



Set reference value to RICI =5. That means 77% are to The left of the line.

Predictive Model Output if used in Southern Nevada



How much is it worth?

- Each one unit change in RICI was equivalent to a 10.4% reduction in average annual outdoor irrigation use in S. NV.
- WER calculates with the assumption of a 10% reduction in outdoor use for each one unit of reduction in RICI.
- Again, baseline is set at 5 and RICI's use is optional. Its new and additional data will help confirm its suitability.

But the concept “feels wrong”. Isn’t use ultimately a function of behavior?

- Yes. BUT consider the following.
  - Does a sports car generally use more gas than a subcompact?
  - Does a high butane grill typically burn through a propane tank faster than a low capacity one.
  - Does a home use more water with a ¾” service than with a 5/8” one?

- In each of these cases and countless others, where a human has a hand in the output, while a higher capacity device need not use more resource than a low capacity one, it usually does.
- Higher capacity is associated with higher usage. Some might say higher capacity begets higher usage. I suspect this is only partially true here. Likely covariate with other things. Remember we are using the correlation!

RICI and design – how might this relate to water conservation

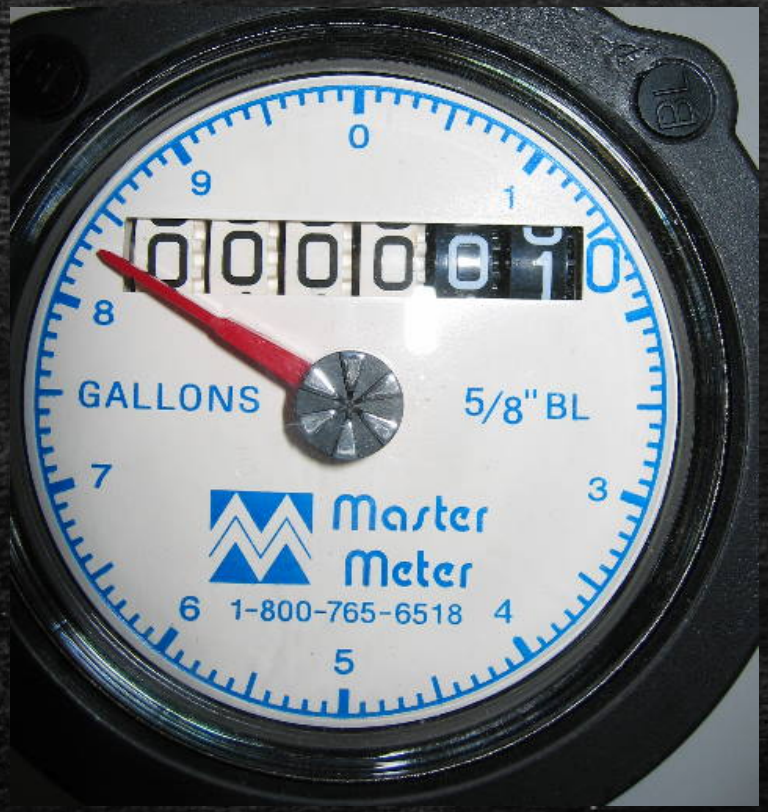
- Consider a stereotypical new home. Lot of 5065 square feet. House and hard surfaces of 2600 square feet. 2398 square feet of irrigated area as defined in the standard.
- All spray irrigated. 2 valves. Turf is on valve 1 and shrubs on valve 2.
- Measure flow rates and come up with valve 1 = 8 gpm and valve 2=8 gpm. Sum is 16 gpm. Dividing 16/2398 and multiply by a thousand = a RICI score of 6.7.
- Now instead of sprays, let's switch valve 2 to point-source drips. New valve 2 = 3 gpm.
- New sum of 11 gpm. Divided by 2398 = a RICI score of 4.58.

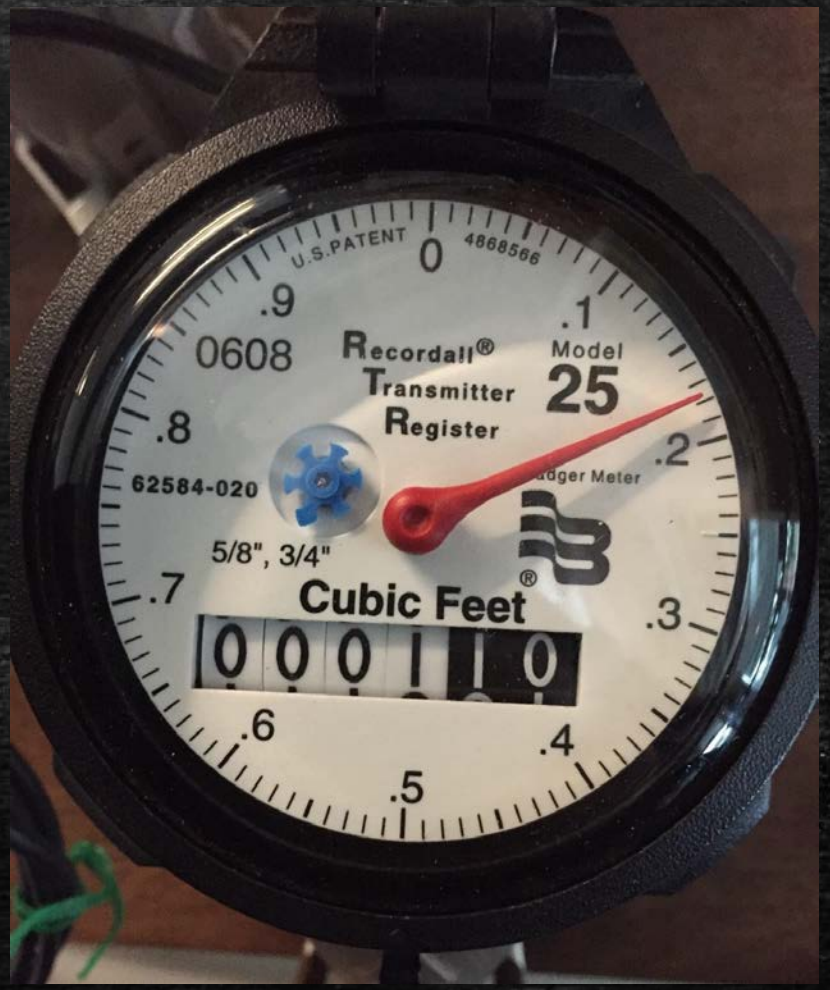
Note that in this example we did not need to know the square footage of the turf or other landscaping, we didn't in fact need to know anything about the plants, nor did we need to know certain plants' water usage characteristics.

Data Required and Training

- Need lot square feet and may need footprint of house and hard surfaces.
  - Use the worksheet to get the *landscape area* or subtract the hard surfaces from the lot square feet to get the necessary area data.
- Need to get flow rates
  - Best to set irrigation controller to run each station for a couple minutes. This provides time for the system to come to an equilibrium flow rate and time to get from the controller to the meter.
  - Measure flow rates by noting start reading and watching for 30 sec and multiplying by 2. Generally for home meters, gallons are marked on the face and each rotation equals 10 gallons for meters that display in gallons. If reading in cubic feet need to do a conversion (each cubic foot = 7.48 gallons).
  - *Sum together the flow rates in gpm*.
- Divide the *summed flow rates* by the *landscape area* and multiply by 1000 to get RICI.

Meters


GALLONS
5/8" BL
Master Meter
1-800-765-6518


U.S.PATENT 4868566
0608
Recordall®
Transmitter
Register
Model 25
62584-020
5/8", 3/4"
Cubic Feet

Looking forward to the use of RICI and the data that will come in.

Questions?

Kent Sovocool

Senior Conservation Research Analyst

Kent.Sovocool@snwa.com

702-862-3738