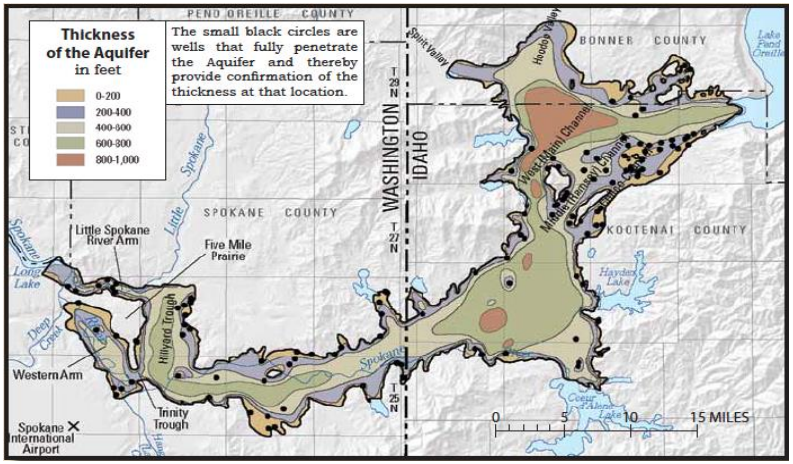
WISDM

Watershed Integrated System Dynamics Modeling

Allyson Beall King and Melanie Thornton



WASHINGTON STATE UNIVERSITY

CERE

USDA

NSF

State of Washington Water Research Center

BioEarth

Biosphere-relevant earth system model

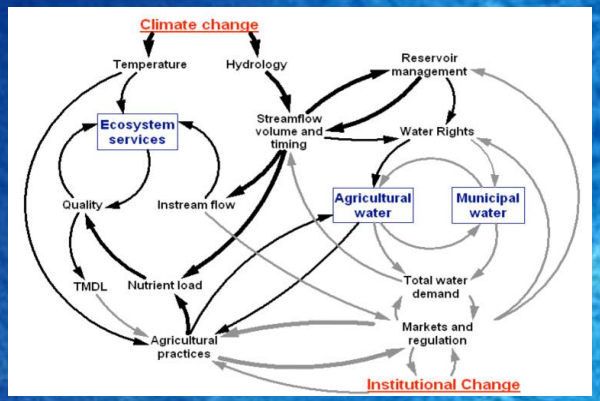
Collaborative Modeling in the Spokane River Basin

Melanie Thornton

Why Models?

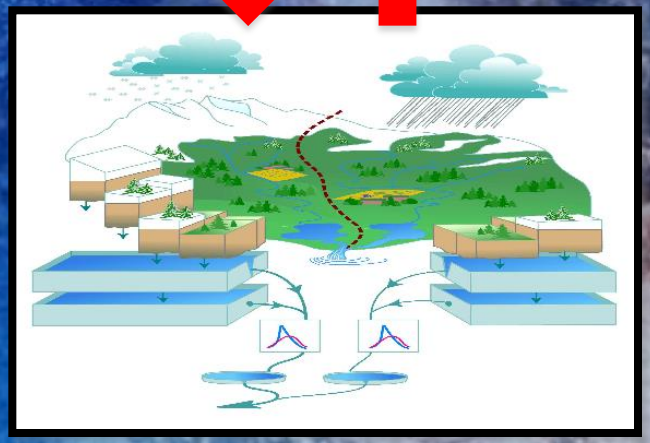
MODELS AS A PLATFORM FOR DIALOGUES

- Research vs. Management Models
- Learning tool
- Decision support tool
- Explore future scenarios



Collaborative Modeling Process

- Individual conversations with many water resource professionals
- Brings stakeholders together
- Discuss water issues and alternatives



Collaborative Modeling Process

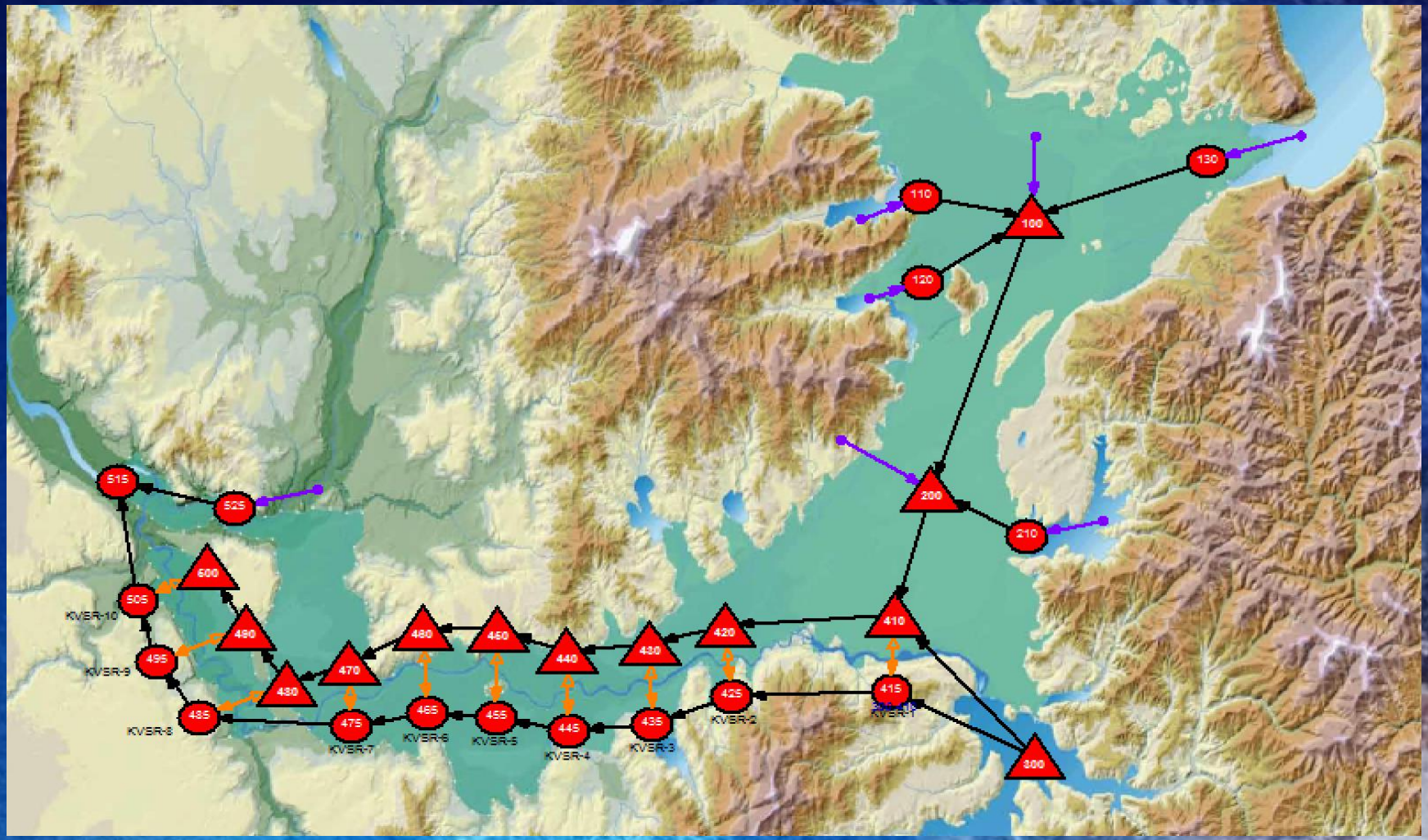
- Can address resource management challenges
- Stakeholders integrate differing perspectives and interests
- Participants build a shared language and identify areas of agreement and disagreement
- Can clarify assumptions and facts, while building trust in the process.

Collaborative Modeling: OASIS

- Working with HydroLogics Inc (Dan Sheer)
- Water Management Issues
  - Analysis
  - Planning
  - Conflict resolution
- OASIS
  - Computer modeling program

http://www.hydrologics.net/oasis.html

Interface: Version 0



OASIS

- Model of hydrology
- Built upon robust dataset
  - Tested and vetted
- Analyzes information
- Determines water flow time tables
  - Impacts on future water availability
- What if scenarios

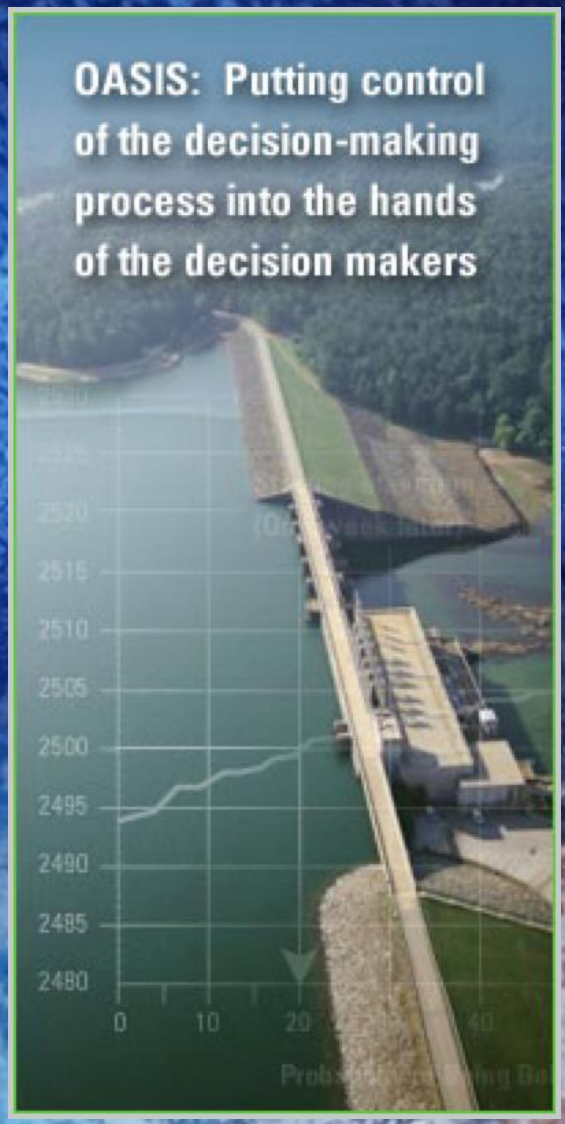
What if the climate changed?

What if pumping doubled in Washington? Idaho?

What will have the most beneficial use of unused water allocations?

Why OASIS?

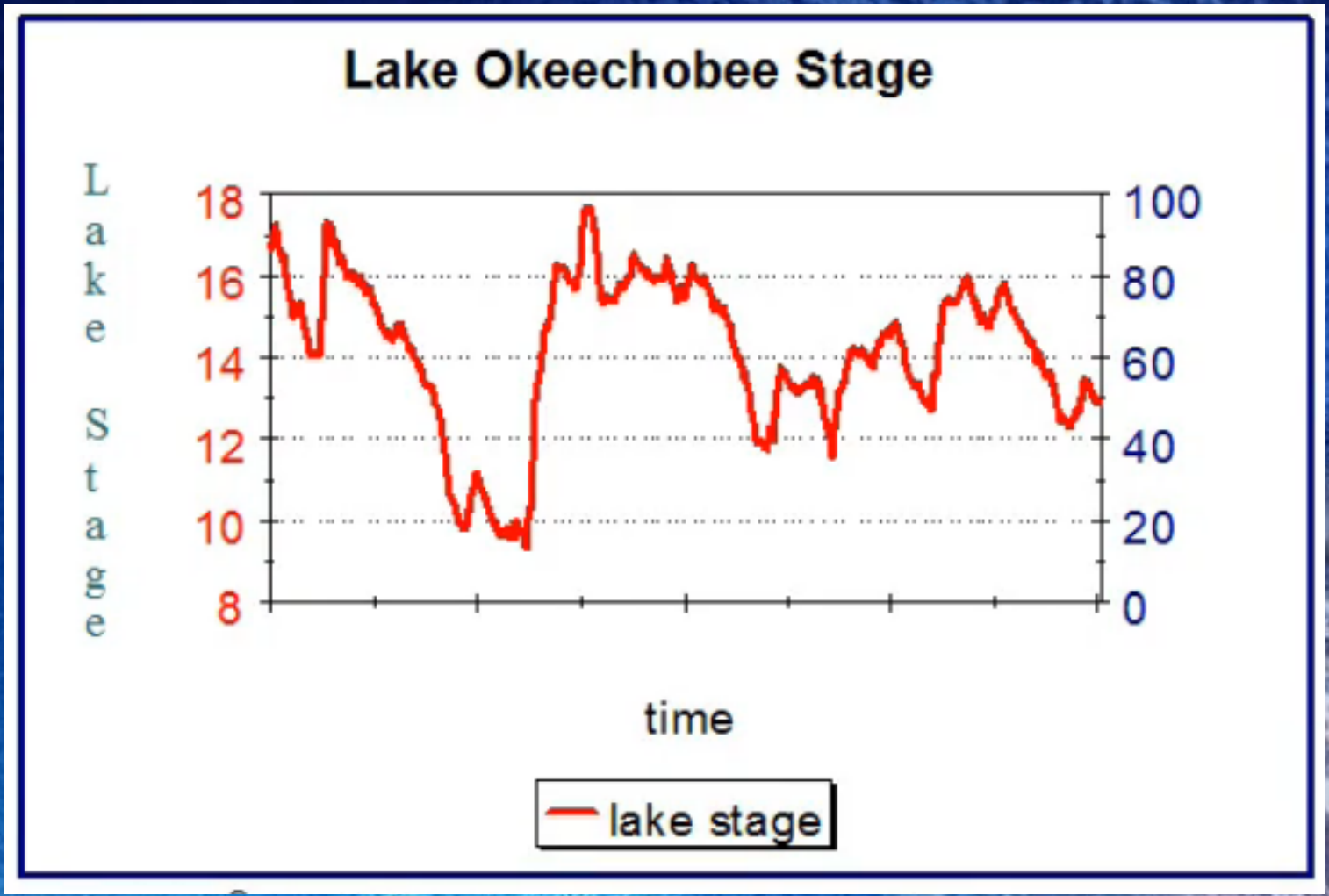
- Used on 20% of nation's water supply
- It is capable of modeling virtually any water system in the world
  - From small and simple to large and complex.



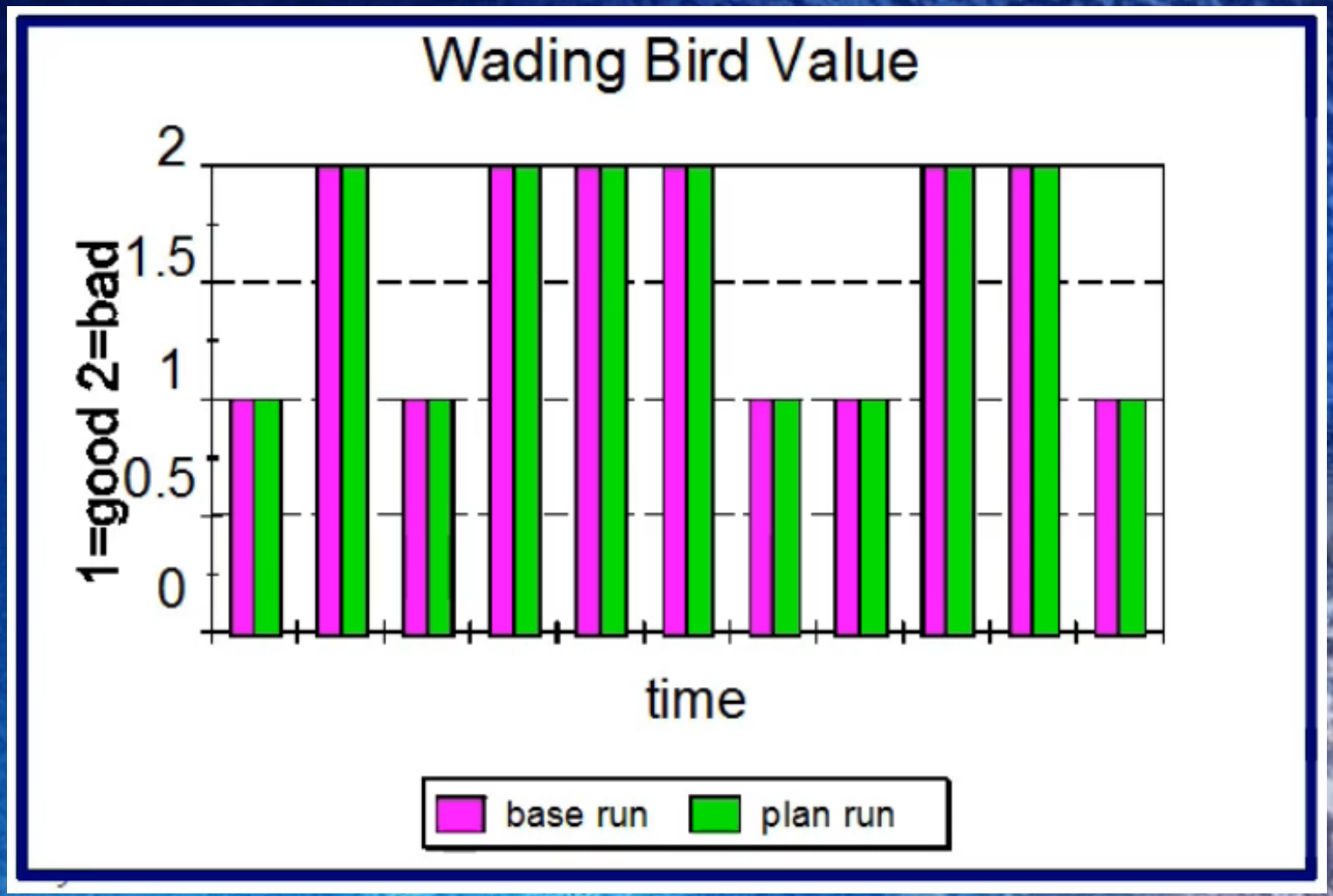
Performance Measure (PM)

- It's a way to compare alternatives for one or more management objectives
- Facilitates in distinguishing "better" or "worse"
- Water resource problems are multi-objective
- Some possible PM
  - Water supply reliability
  - Streamflow
  - Water quality
  - Recreation
  - Hydropower
  - Environmental measures

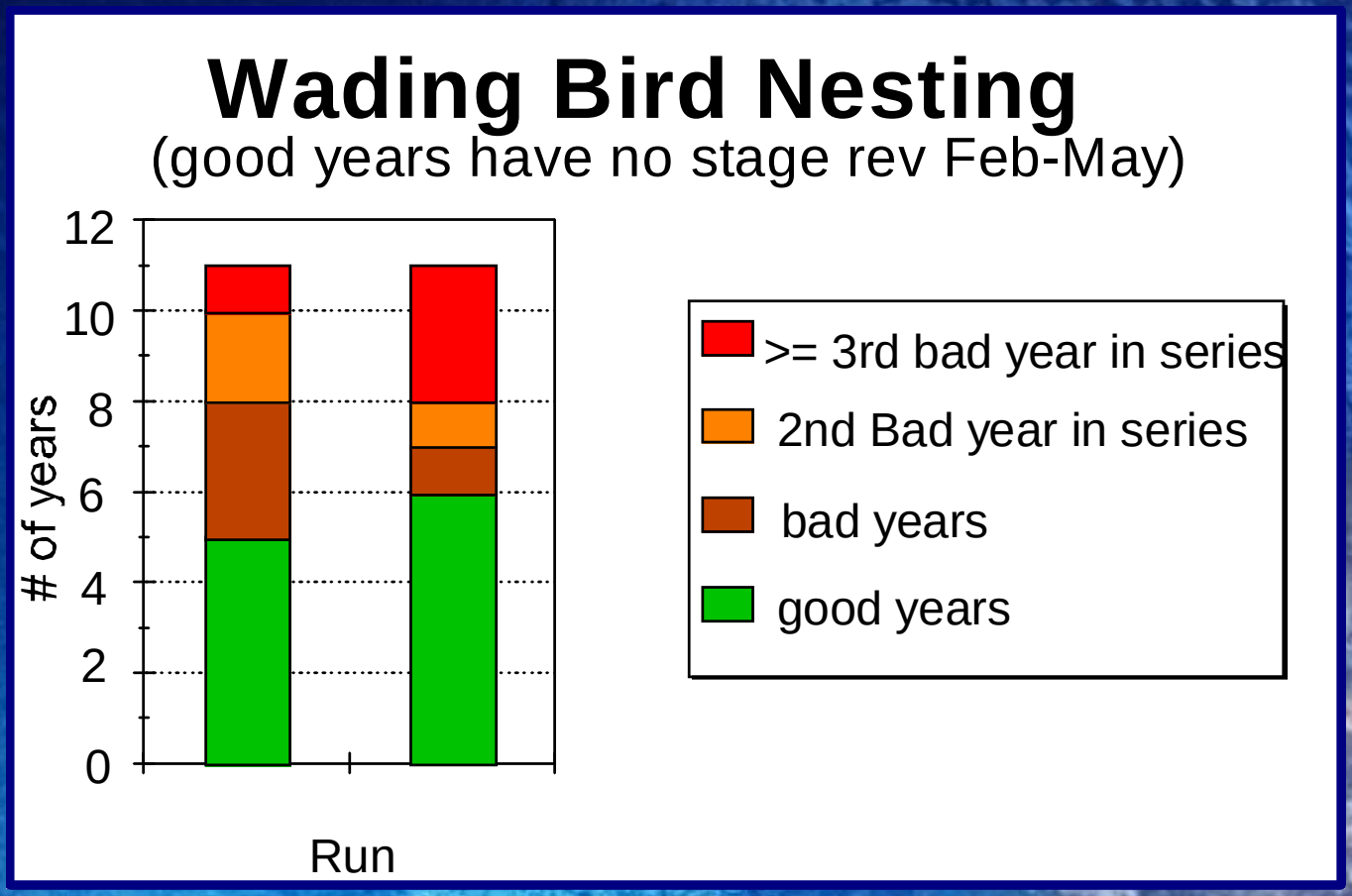
Performance Metrics Example



Performance Measures: First Attempt



Performance Measures Revised

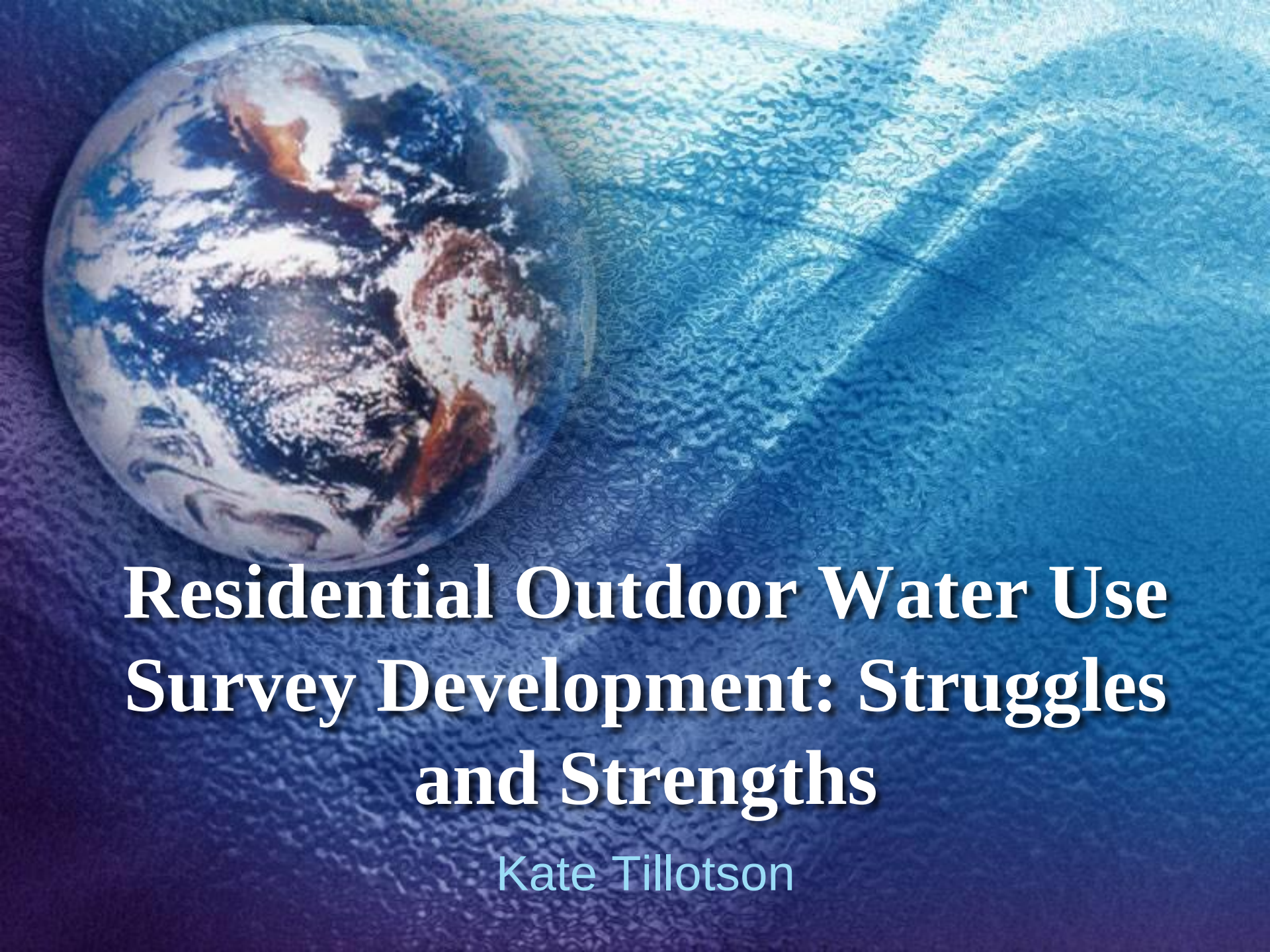


Collaborative Modeling Value:
The Value of Research

- Value added research that benefits the public
- Provides opportunity for discussion and collaboration
  - Express individual interests
  - Develop a mutually acceptable solution to complex problems
  - Work together

Stakeholder Workshops:
Tentative Plan

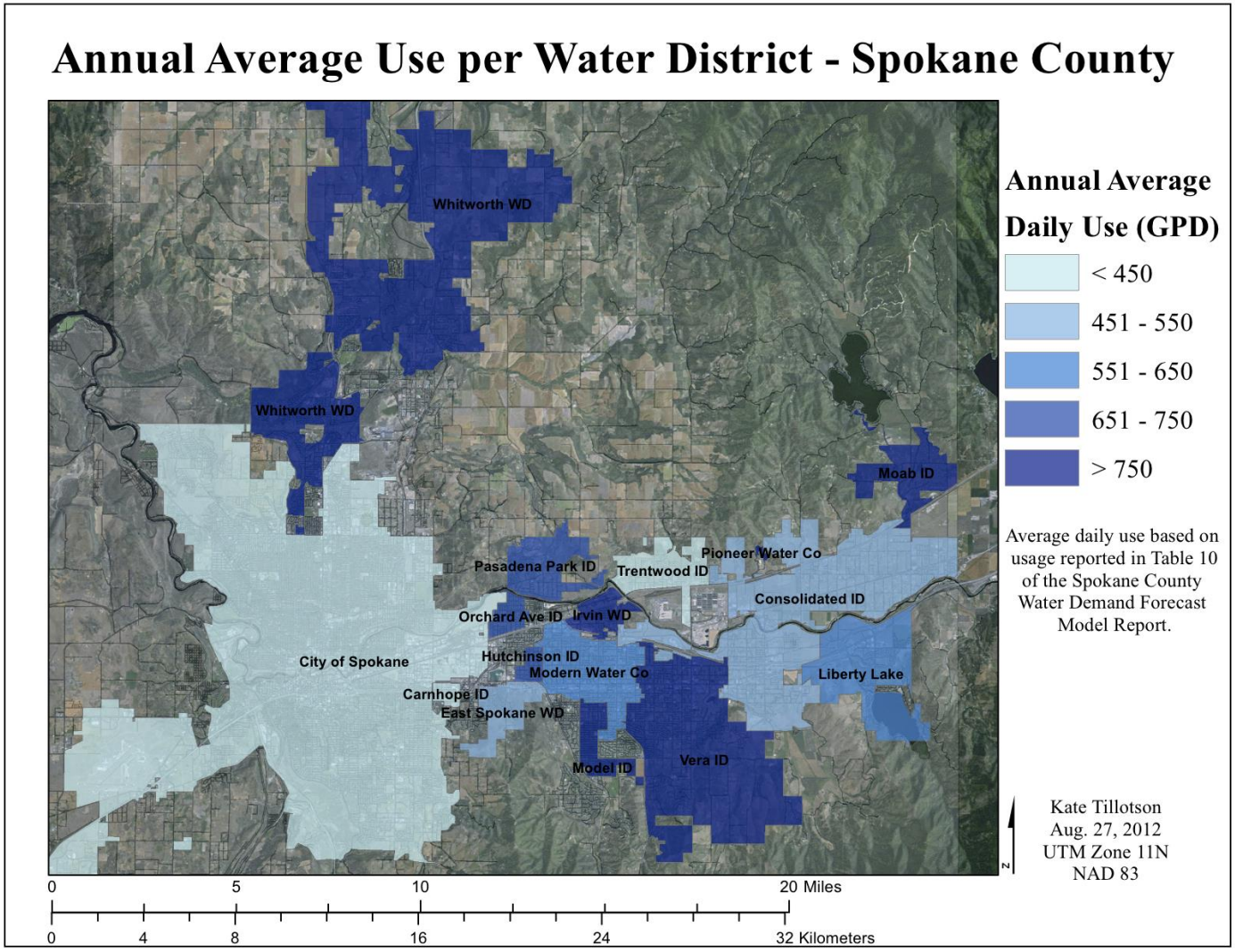
- Summer (June/July):
  - Model vetting process
  - Model ready to simulate
- Early Fall
  - Workshops began
- November:
  - Spokane River Water Forum
  - Half-day Collaborative Modeling Session



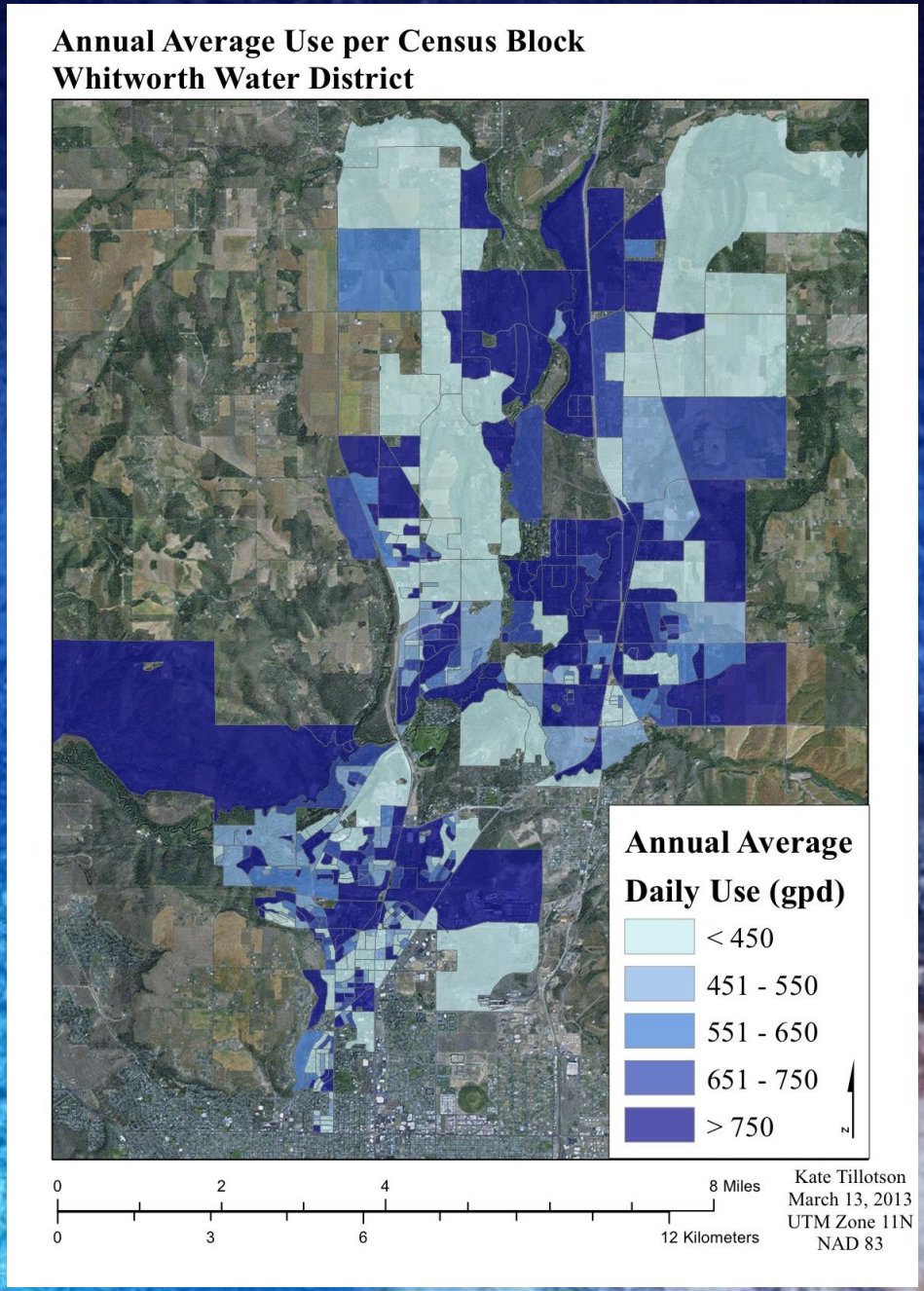
Residential Outdoor Water Use Survey Development: Struggles and Strengths

Kate Tillotson

A little background: Spokane



A little background: Whitworth Water District

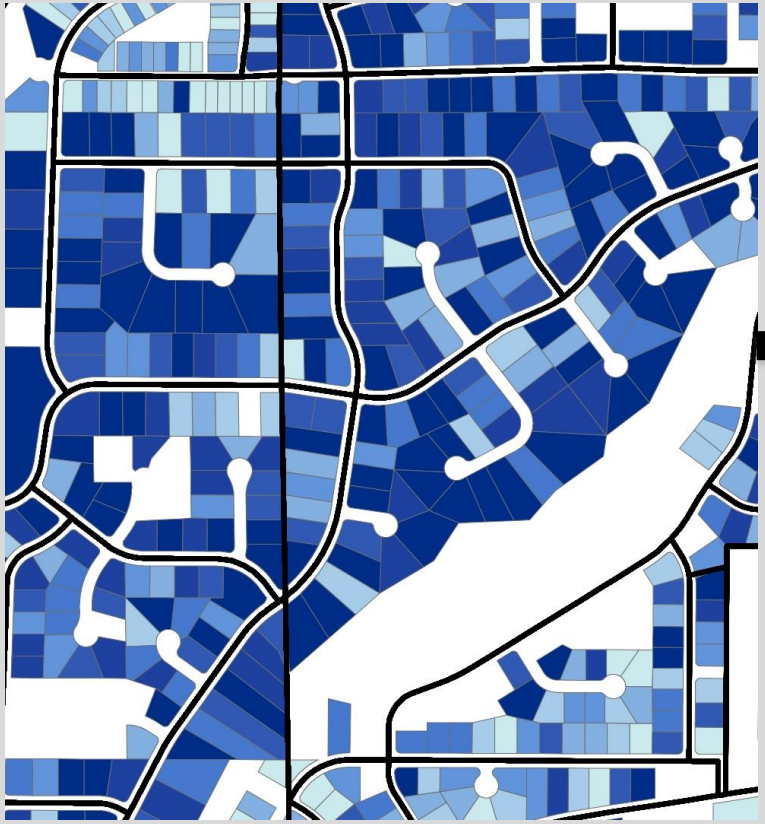


Struggles

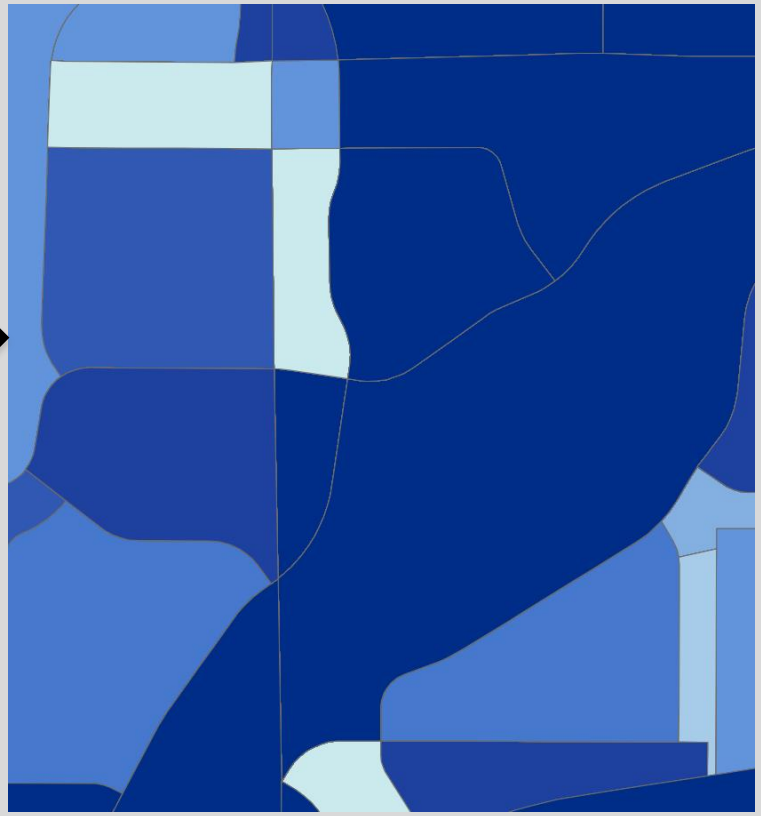
- Spatial scale – what is a meaningful area or unit of measure?
- Controlling for variables
  - Things I can control for: summer outdoor use, acreage (irrigable area)
  - Things I can with a survey: education, income, awareness of regional water issues
- Data Collection – what is a meaningful population? Electronic vs. paper? Mailing vs. in-person?

Spatial Scale

Water use by parcel



Water use by census block



Variables

- Behavior
  - Timing of lawn watering
  - Length of watering
  - Gardens vs. lawns
- Watering systems
  - In-ground vs. above ground
  - Timed vs. untimed
- Socio-economic
- Social
  - Neighborhood norms
  - Personal relationship with nature
  - Awareness of water resource issues in Spokane

Variables

Variable	Relationship with water demand	Reasoning	Sources
Income	+	-Can afford higher bills - Luxuries (pools, large lots/big lawns in-ground irrigation)	Corbella and Pujol, 2009; Hoffman et al, 2006; Ardensen, 2008; Hoffman and Worthington, 2008; Franczyk and Chang, 2009; Russell and Fielding, 2010
	-	-Can afford new water-conserving appliances/irrigation systems - Acts as education proxy and higher education tends to show lower use	Corbella and Pujol, 2009; Hoffman et al, 2006; Ardensen, 2008

Variables

Variable	Relationship with water demand	Reasoning	Sources
Age	+	- Young children and retirees use more water - Retirees have time to maintain gardens, spray down sidewalks, water lawns	Anderson, 2008; Arbués et al, 2003; House-Peters et al, 2010
	-	-Working age people have less time to less time to water lawns - Retirees may have more water conserving behaviors - Lower incomes of retirees may make them more vulnerable to high bills	Nauges and Thomas, 2000; Shove, 2003; Binet et al, 2006; Nauges and Reynaud, 2001

Variables

Variable	Relationship with water demand	Reasoning	Sources
Neighborhood Norms	+	-Internalized sense of neighborhood expectations -Observed watering habit of neighbors -Perception that neighbors aren't saving water means they don't need to either	Dorsey, 2010; Iverson Nassauer et al, 2009; Zmyslony and Gagnon, 2000
	-	-Internalized sense of neighborhood expectations -Observed watering habit of neighbors	Corral-Verdugo et al, 2002; Kurz, 2002; House-Peters et al, 2010

Variables

- Identify different audiences based on awareness of issues and their relationship to nature
  - Situation theory
  - New Ecological Paradigm
    - says that humans are still ecologically interdependent as with other species and are impacted by the cause, effect, and feedback loops of ecosystems

Survey

- Method choices: Physical cover letter that sends participants to an electronic survey.
- Strengths/weaknesses
  - Paper gets better response rates...but data entry would be time consuming
  - Electronic gets lower response rates...but saves time on data entry

Questions the came out of the literature

- Habits
  - Lawn use
  - Sprinkler system (number of, in- or above-ground, timing, frequency, length)
- Demographics and SES
  - Income, home value
  - Number of residents, age
  - Education level, employment
  - Age of home

Billing comprehension

Do you understand the structure of your water bill? Y/N

Do you know the cost of water from your water provider? Y/N

	Strongly Disagree	*Somewhat Disagree*	*Unsure*	*Somewhat Agree*	*Strongly Agree*
Is your water bill easy to understand?	1	2	3	4	5

Select the rate structure that best describes the one used by your water provider:

Graduated block pricing – customer's water usage is divided into several blocks so that the price paid for the *additional* unit of water increases as a resident's water usage increases from one block to the next. (For example, you might pay $10/unit up to 100 units. But if you use 101 – 200 units you pay $12/unit and if you use 201 – 300 units you pay $15/unit.)

Flat rate structure – users are billed the same rate every month regardless of amount of water used. (For example, each bill is $50 and it does not increase if more water is used and does not decrease if water is saved.)

Uniform rate structure – customers pay the same price for every unit of water that they use. The unit price of water does not change based on how much water you use. (For example, when buying gasoline you pay the same amount per gallon whether you fill your tank completely or put in just a few gallons.)

Declining block rate structure – a consumer pays less per additional unit of water as usage increases. (For example, you might pay $15/unit up to 100 units. But if you use 101 – 200 units you pay $12/unit and if you use 201 – 300 units you pay $10/unit.)

Not sure

Neighborhood Norms

Cultural/Neighborhood Norms

Do you belong to a neighborhood association? Y/N

If yes, does your neighborhood association have requirements for lawn maintenance? Y/N

For the following statement indicate how strongly you disagree or agree.

	Strongly Disagree	*Somewhat Disagree*	*Unsure*	*Somewhat Agree*	*Strongly Agree*
Having a green lawn is important to me.	1	2	3	4	5
Having a green lawn is important to my neighbors/my neighborhood.	1	2	3	4	5

For the following statement indicate how strongly you disagree or agree.

	Strongly Disagree	*Somewhat Disagree*	*Unsure*	*Somewhat Agree*	*Strongly Agree*
Compared to my neighbors, I put more effort into my lawn.	1	2	3	4	5
Compared to my neighbors, I use more water on my lawn.	1	2	3	4	5

Relationship with local environment

Relationship with local environment

For the following statements indicate how strongly you disagree or agree with each scenario.

Information Processing

The following issue is a serious problem for this area:

Information Seeking

I would like to better understand the following issues:

Constraint Recognition

I can personally do something about the following issue:

	Strongly Disagree	*Somewhat Disagree*	*Unsure*	*Somewhat Agree*	*Strongly Agree*
Low water level or no water in the Little Spokane River or Spokane River	1	2	3	4	5
My land use and its role in Little Spokane River or Spokane River quality	1	2	3	4	5
Fertilizer in the Little Spokane River or Spokane River and its impact on fish habitat	1	2	3	4	5
How changes in precipitation might impact the uses of the Little Spokane River or Spokane River	1	2	3	4	5
Environmental regulations for Little Spokane River or Spokane River management	1	2	3	4	5

Willingness to change behaviors

How willing or unwilling would you be to take each of the following actions in the future if you knew they would improve river levels?

	Don't know	*Unwilling*	*Somewhat willing*	*Quite willing*	*Very willing*
Planting native or drought-resistant vegetation	1	2	3	4	5
Reducing indoor water use	1	2	3	4	5
Reducing outdoor water use	1	2	3	4	5
Changing lawn watering habits	1	2	3	4	5

New Ecological Paradigm

Perceptions of Nature
I personally feel that...

	Strongly Disagree	*Somewhat Disagree*	*Unsure*	*Somewhat Agree*	*Strongly Agree*
Humans have the right to modify the natural environment to suit their needs	1	2	3	4	5
Humans are severely abusing the planet	1	2	3	4	5
Plants and animals have the same rights as humans to exist	1	2	3	4	5
Nature is strong enough to cope with the impact of modern industrial nations	1	2	3	4	5
Humans were meant to rule over the rest of nature	1	2	3	4	5
The balance of nature is very delicate and easily upset	1	2	3	4	5

Thanks