

Speaking not as a scientist, but as someone who works among scientists and has had her perspective shifted as a result.

If anything, I hope the one thing you can walk away with today is an excitement about the potential of scenarios and the value of long-term thinking.

## Why discuss the future of water and people?

“People are embedded parts of the biosphere and shape it, from local to global scales, from the past to the future. At the same time people are fundamentally dependent on the capacity of the biosphere to sustain human development.”

- Carl Folke, Stockholm Resilience Center

Why is future thinking important to you?

Why we thinking long-term thinking is important: We have a profound influence on the planet and on the future. Important things in nature change slowly, so we have to respect slow changes.

Learn more about the Stockholm Resilience Center, a research center focusing on socio-ecological systems and resilience: <http://www.stockholmresilience.org/>




People demand a lot from the Yahara watershed, and so the research team was interested in a suite of ecosystem services, or natural benefits people rely on for their survival and well-being. The quality and health of these services translates as human quality of life. So what this question ultimately means is how can we maintain or enhance our natural benefits today to ensure a high quality of life for future generations?

**Resilience** – the capacity to deal with change and continue to develop...



...or the ability to do something different when what you're doing isn't working

**Thinking about the future can be difficult,  
but we can...**

- 
- **Embrace uncertainty, and assume it is changeable and influenced by both humans and nature.**
  - **Honor the diversity of perspectives.**
  - **Emphasize learning.**
  - **Expect the unexpected.**

**Importantly, we can make choices.**

**“While the future is uncertain and much of it is beyond our control, we can control many aspects of it. We choose our future: we create it by what we do or fail to do.”**

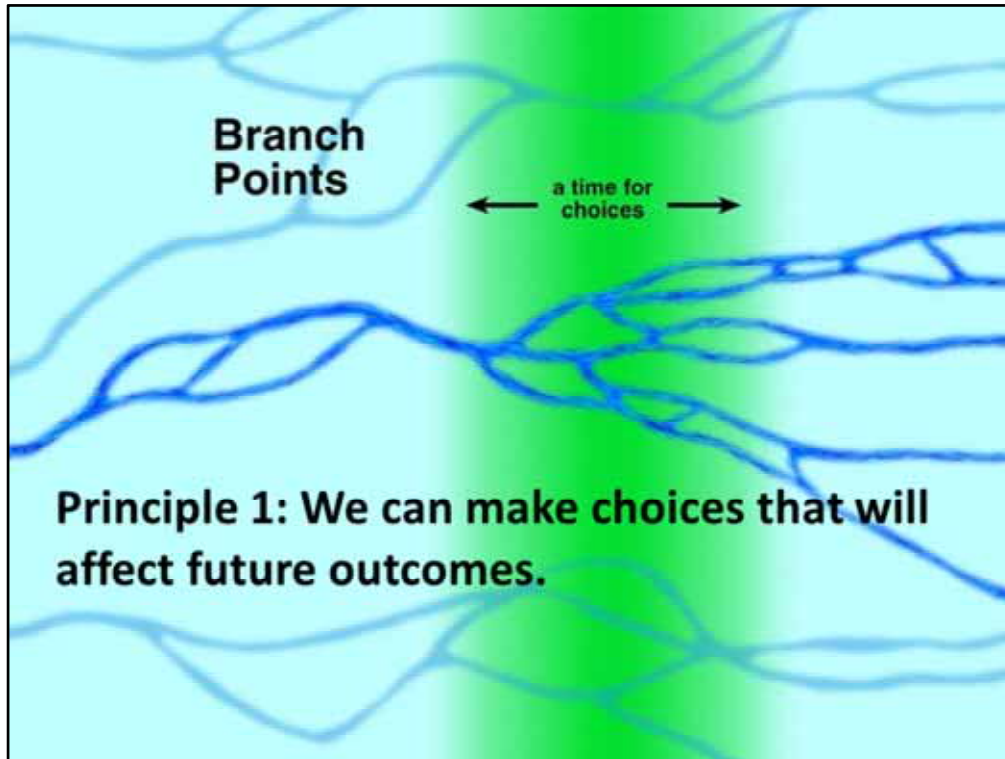
**– Wendy Schultz, futurist**

Despite the uncertainty of the future, it is important to remember we can make choices, and through our choices, we can shape the future.

This leads us to the very basics of long-term thinking....

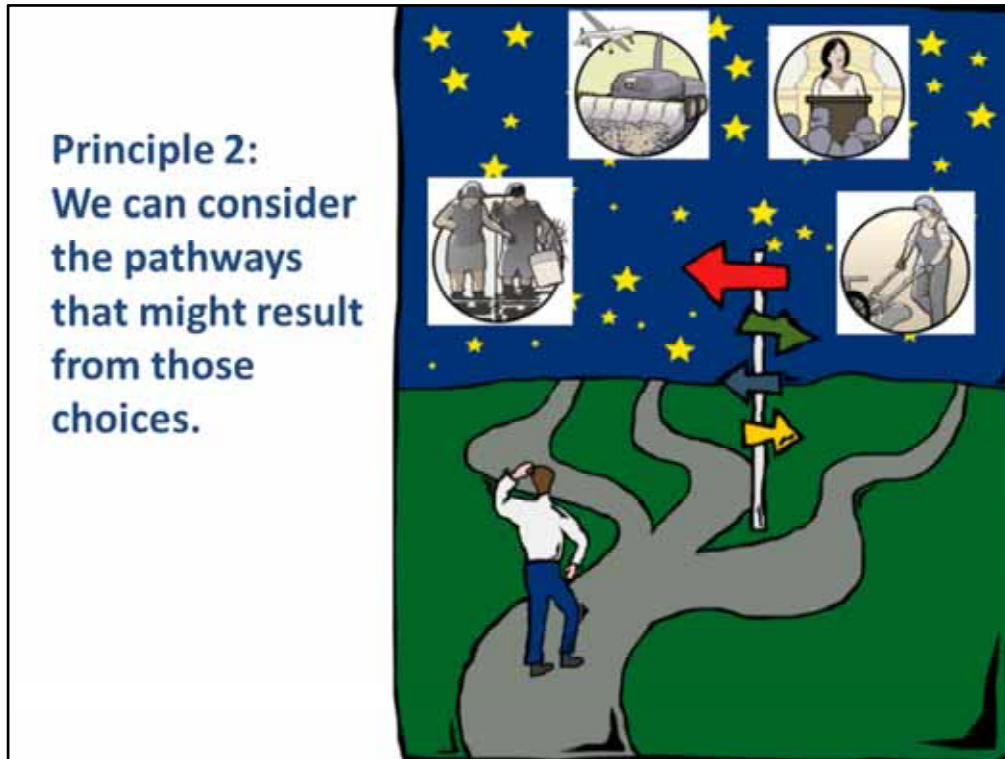
Bio for Wendy Schultz: <http://www.csap.cam.ac.uk/network/wendy-schultz/>

Futurist = a person who studies the future, especially on the basis of current trends



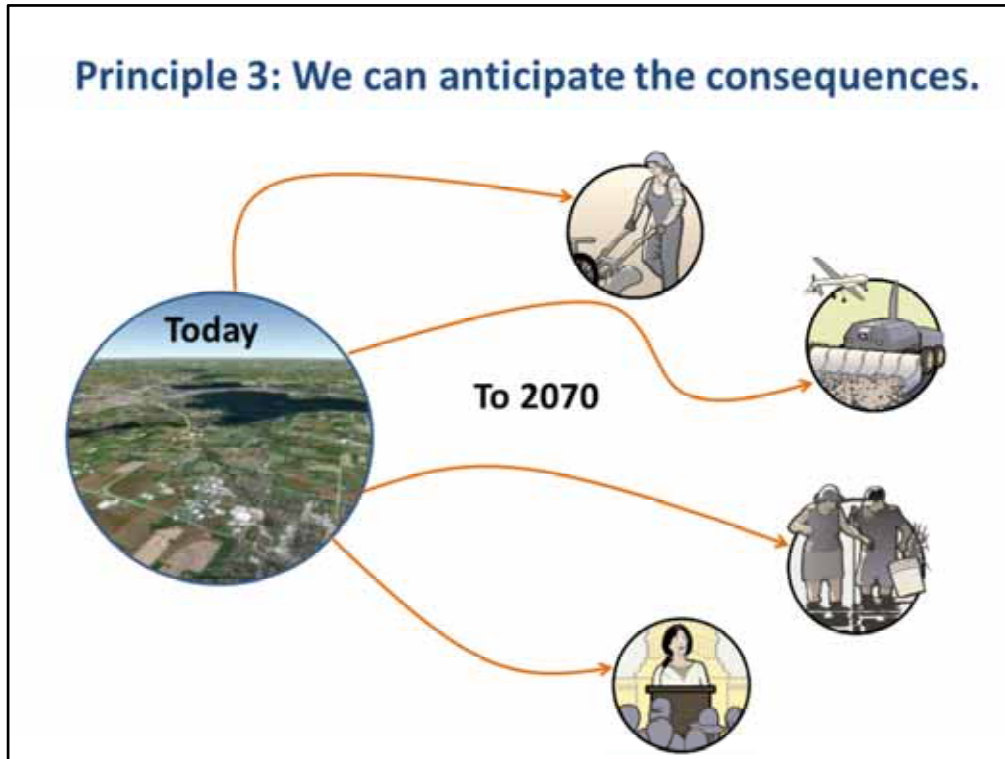
Thinking about the future can be difficult in our culture. We don't normally operate in long time scales—deadlines, election cycles, budget cycles, soccer practice.

First principle: Despite the uncertainty of the future, it is important to remember we can make choices, and through our choices, we can shape the future.



A second basic principle of future thinking is thinking about what might happen as a result of the numerous choices we face. Importantly, in thinking about the changes that might be possible, we can make ourselves more ready for surprises that might happen along the way – thus making us more resilient.

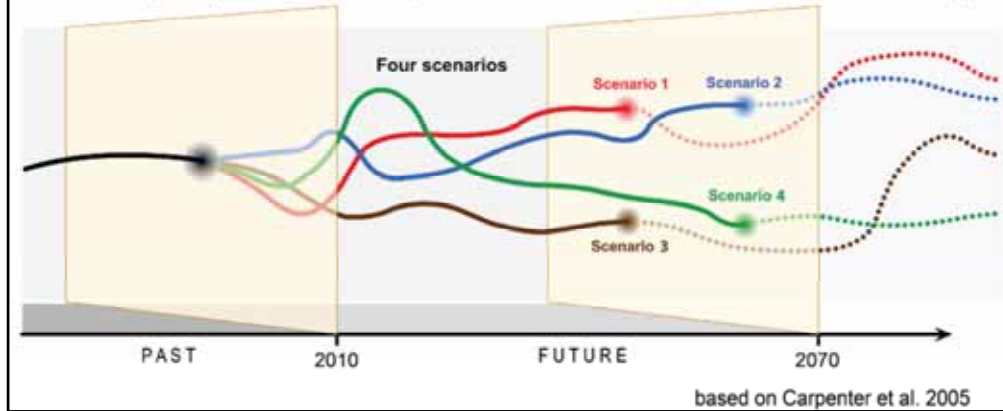




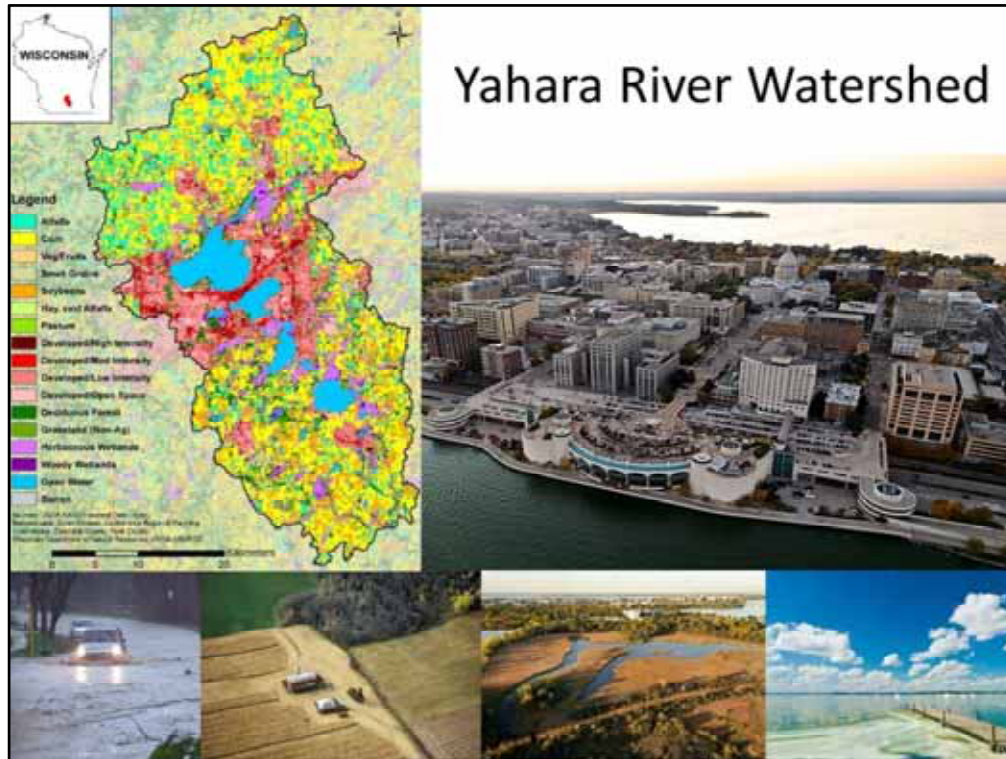
Principle 3 of future thinking: anticipating the consequences of our choices.

## Scenarios help us consider changes and choices

- Provocative, plausible stories about the future with contrasting social and environmental conditions.
- They explore questions of “What if?” and facilitate long-term thinking.
- They help us learn ways to address change and vulnerability.



Here is where scenarios come in. Scenarios are designed to make thinking about our choices and the pathways to where they could lead us easier.



There's a lot happening that makes it an interesting place to study. Urban life and ag co-exist. It's where we live. Presents an interesting complex problem – how to improve water quality, given the demands of agriculture, land-use change, and humans?

Why would we study a watershed specifically? This scale is strategic when it comes to thinking about the future of water, land, and people.

When considering regional social-ecological systems, watersheds are often a convenient scale for analysis

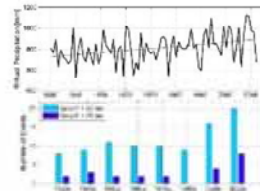
They are natural & widely accepted units for natural resources management  
 Boundaries and flow paths organize hydrologic and biogeochemical processes that underpin features and processes such as water supply, flood protection, and food production

The Yahara is an urbanizing, agricultural watershed—many different people with many different needs compete for ecosystem services

Major challenges include nonpoint source pollution, lake eutrophication, and urban development pressure

## Long-term changes and challenges affecting water

- Intensification of dairy agriculture
- Increasing demand for biofuels
- Urban development
- Changes in climate
  - Increase in annual precipitation
  - More frequent heavy rainfall events

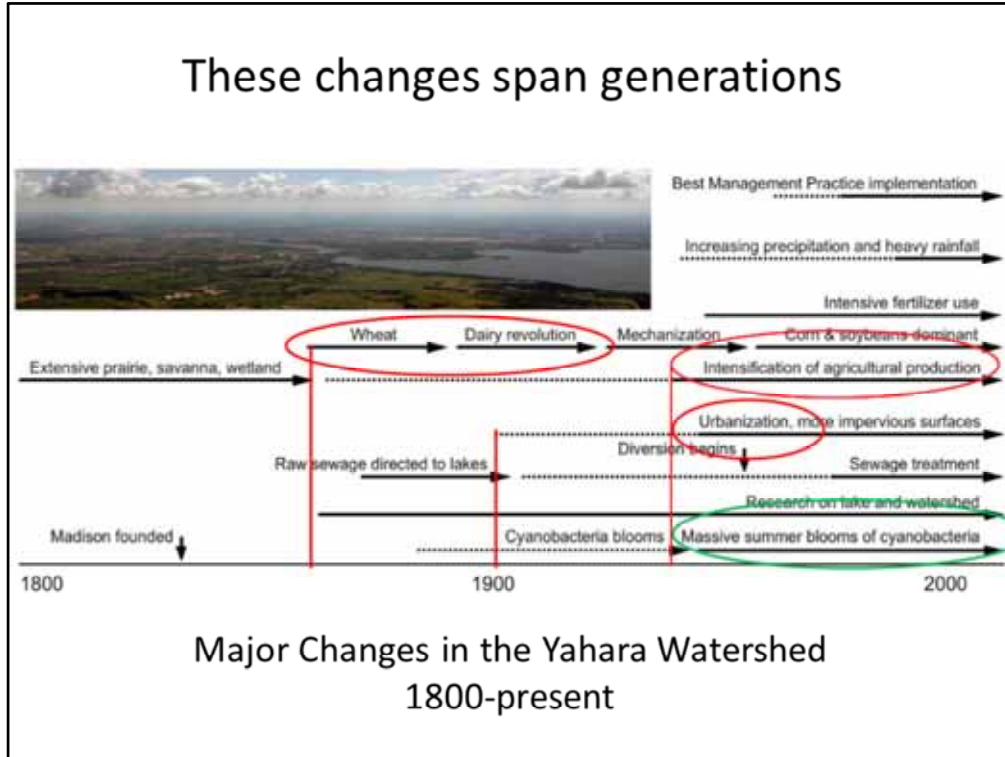


These are the changes and challenges identified as critical to consider for future scenarios in the Yahara

Combined, these changes and challenges create a lot of uncertainty about the future.

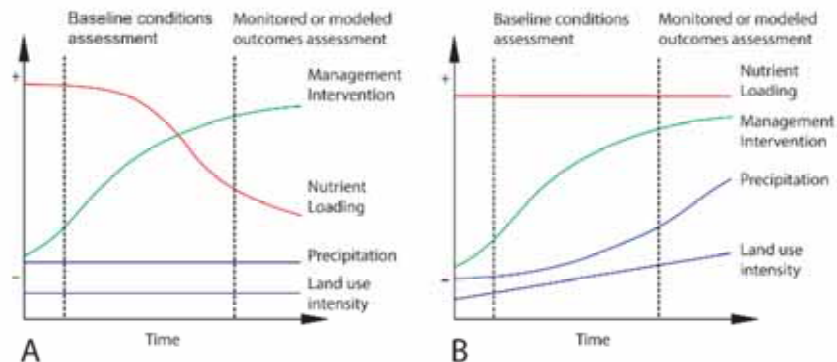
A LOT OF PEOPLE ARE CONCERNED ABOUT REGION'S FUTURE

## These changes span generations



This timeline illustrates the long-term nature of slow environmental change in Yahara Watershed. The changes that brought about today's surface water quality problems are circled.

## A consequence: persistent water quality problems



One of the most visible consequences of these challenges is poor surface water quality, caused by nutrient pollution, especially phosphorus (P) pollution.

Over the past three decades, there has been no notable improvements in water quality, despite increases in ag and urban best management practices. This is due mostly to increased frequency of extreme precipitation events and increasingly difficult manure management—or long-term trends in climate, agricultural land use, and human demand (via demand for dairy products).

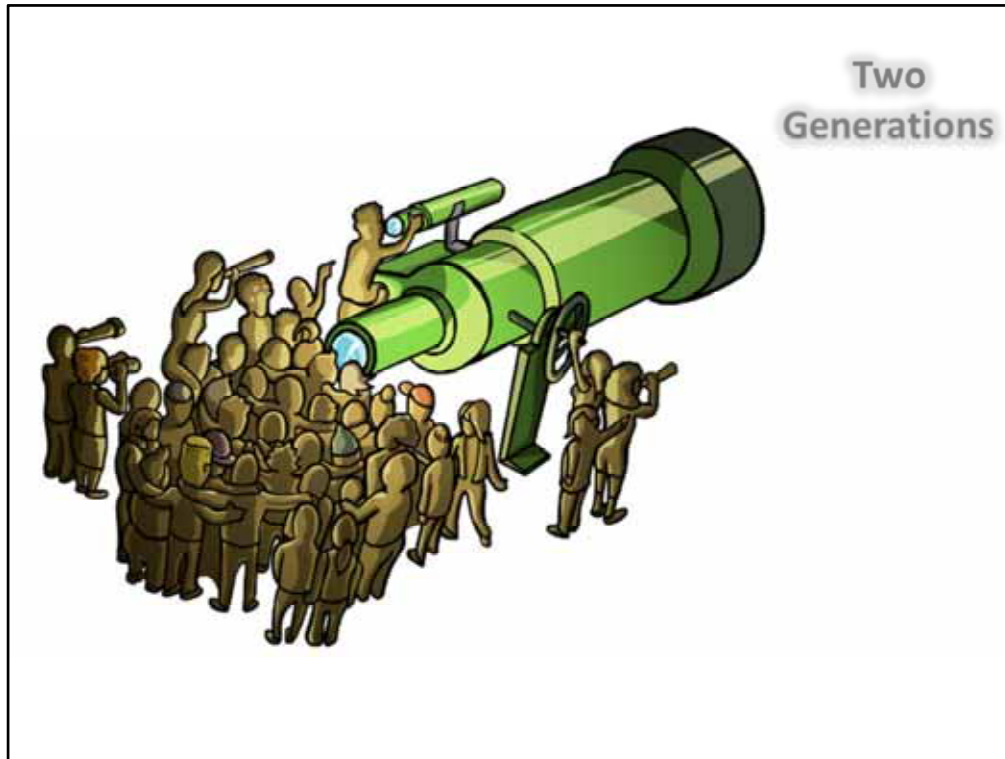
This is a long-term problem caused by several long-term changes and challenges, and provides the contextual platform for the Yahara 2070 scenarios

# YAHARA2070



How can we build water sustainability and climate resilience *now* for *future* generations?

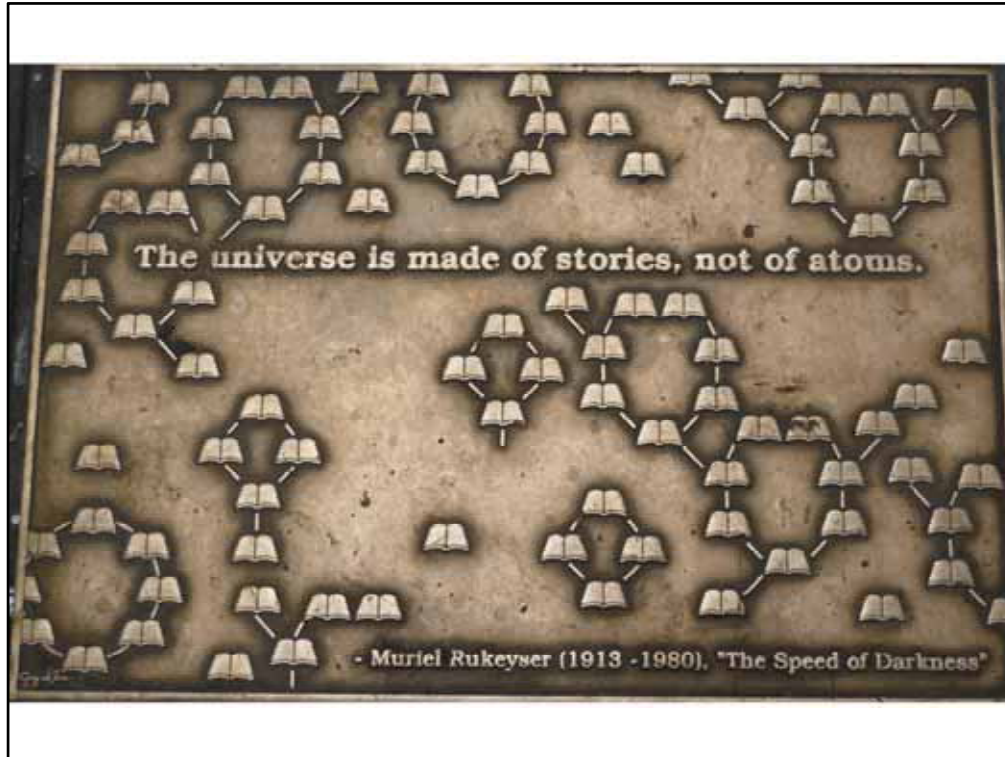
Yahara 2070 is designed to help us think through possibilities for the watershed from today until the year 2070, given these long-term changes and challenges, and to help us imagine what kind of future is desirable and what solutions would get us there.



2070 is 2 generations into the future. This is significant because it's long enough away that it allows us to really be creative with our thinking, but not so long away that we feel we have no connection with it—many of us may have people in our lives right now that could still be alive by 2070.

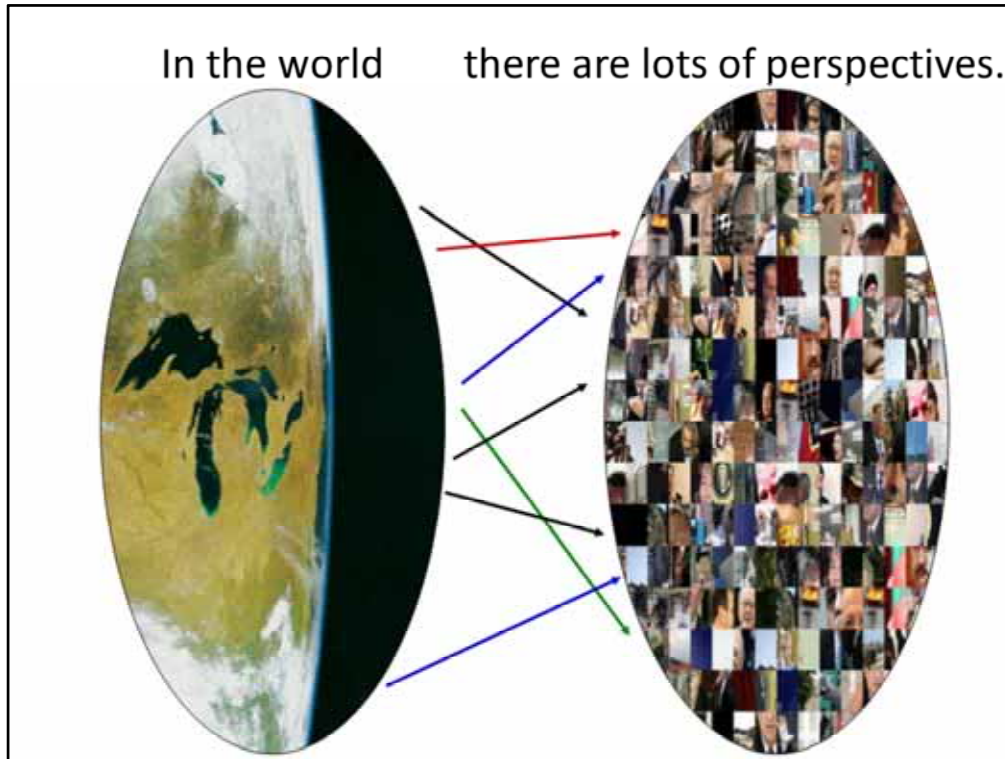
How did the WSC project look two generations into the future? The research team is certainly not making predictions, as no one can predict the future. Instead, the scenarios are based in one of humanity's most powerful tools for change: our imaginations.





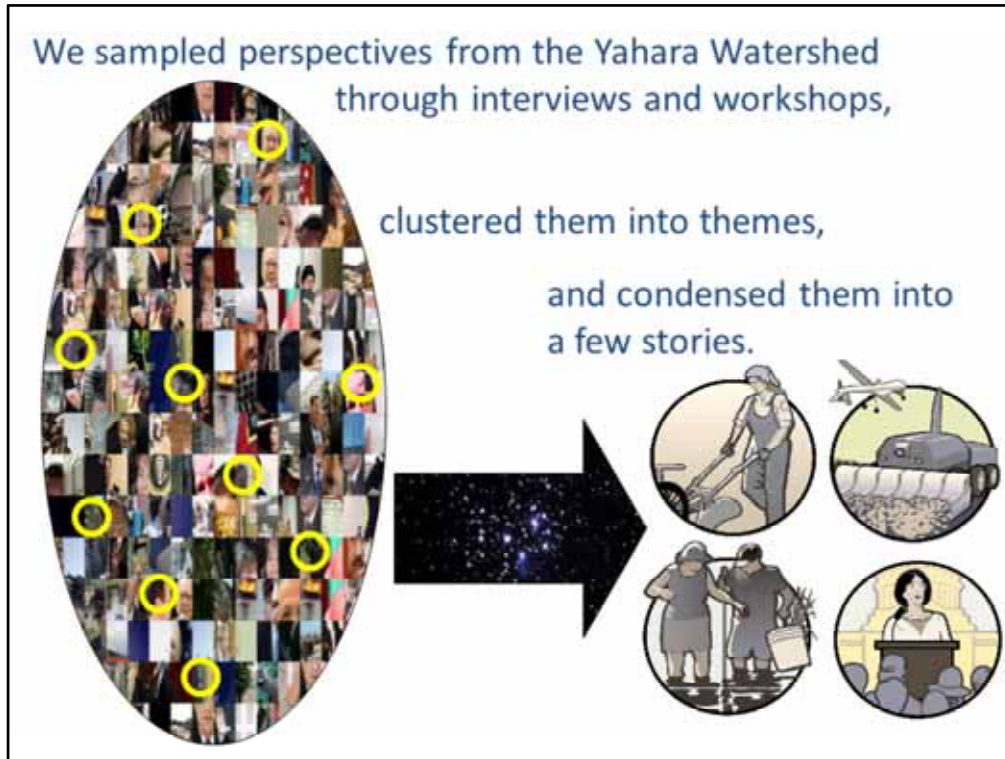
With our imaginations we can create stories that connect us with future generations. Re: this quote by poet Muriel Rukeyser – we argue that the universe is made of both stories and atoms, but the stories come first.

Humans are a storytelling species. We use stories to help us make sense of the world and the future. Through stories, we can explore the different decisions we could make and the potential consequences thereof. We can't predict the future, but we can imagine what it looks like.



But the scenarios are not products of the research team's own imagination. Instead, they come from the imaginations of people who live in the watershed.

We all have our own imaginations and our own ideas about how the future could look, or how we want it to look. But we can't possibly ask everyone what they think.



So the research team did what scientists do: they took samples of the watershed's population.

They asked real people who live here about their hopes, fears, and outlooks for the future. Then clustered those responses into themes, and condensed them in four stories.

## The stories



<b>Name:</b>	<b>Nested Watersheds</b>	<b>Abandonment &amp; Renewal</b>	<b>Accelerated Innovation</b>	<b>Connected Communities</b>
<b>Dynamics:</b>	<b>Adaptation</b>	<b>Transformation</b>	<b>Adaptation</b>	<b>Transformation</b>
<b>Key Factor in Change:</b>	<b>Government</b>	<b>Inaction</b>	<b>Technology</b>	<b>Values</b>
<b>Nutshell:</b>	<b>Government intervention maintains nature's benefits</b>	<b>Disaster decreases population, leads to reorganization</b>	<b>Massive growth in technology businesses, including green tech</b>	<b>Global shift in values toward sustainability</b>

Each based on a different set of human choices and biophysical events

Each story is based on a particular set of human choices and biophysical events that lead to different futures.

When you tell stories, you need a way to frame them. So we framed our stories based on a different force of change that we derived from themes in the interviews and in the scenarios literature. In reality all of these forces play a role in the future, but for the sake of our stories, we picked one to carry each story.

The land-use changes and human choices that happen in the scenarios are a result of the forces of change.



The trigger of change – water crisis



Climate and food crises, lack a resources to bail us out

## Accelerated Innovation

What if we prioritize technology to solve water and climate challenges?





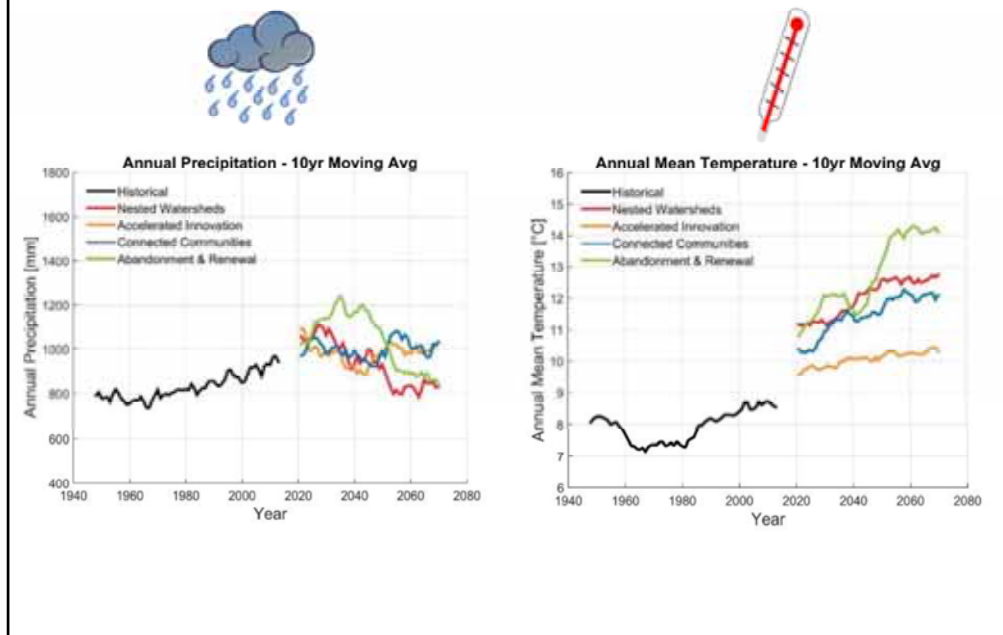
What if we shift our values in response to water and climate challenges?

**Connected Communities**

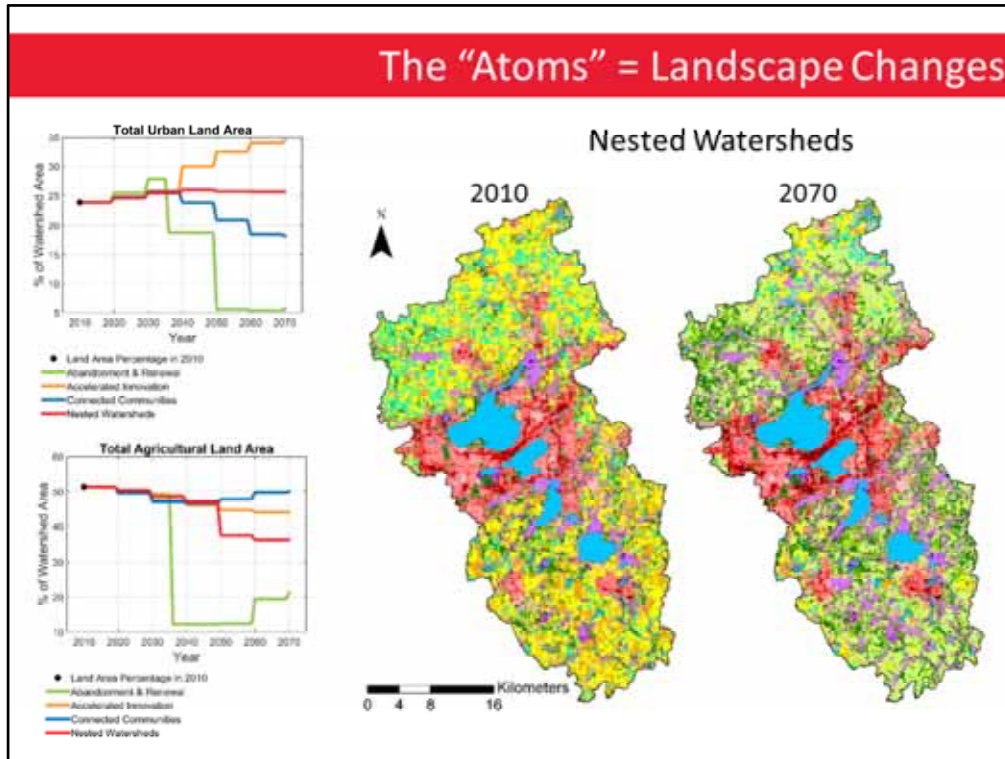
Catalyzation of a movement



## The “Atoms” = Climate Changes



These graphs illustrate what these “atoms” look like in reality. Each scenario was given a different climate, with trends in annual precipitation and temperatures through 2070, which were based on downscaled IPCC climate models.

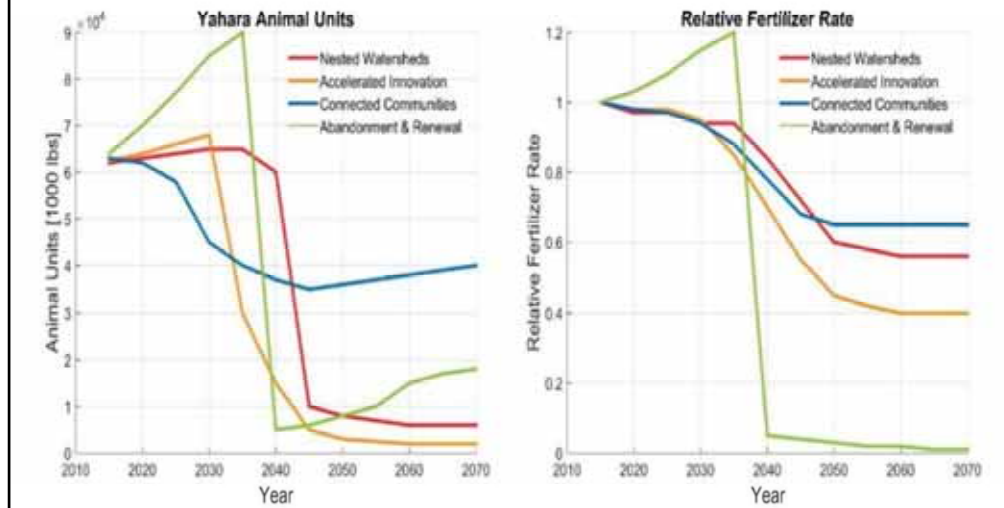


Land-use changes took the form of trends in how urban, agricultural, and natural landscapes change over time as a result of the social changes that occur in the stories, such as policy change and consumer demand changes.

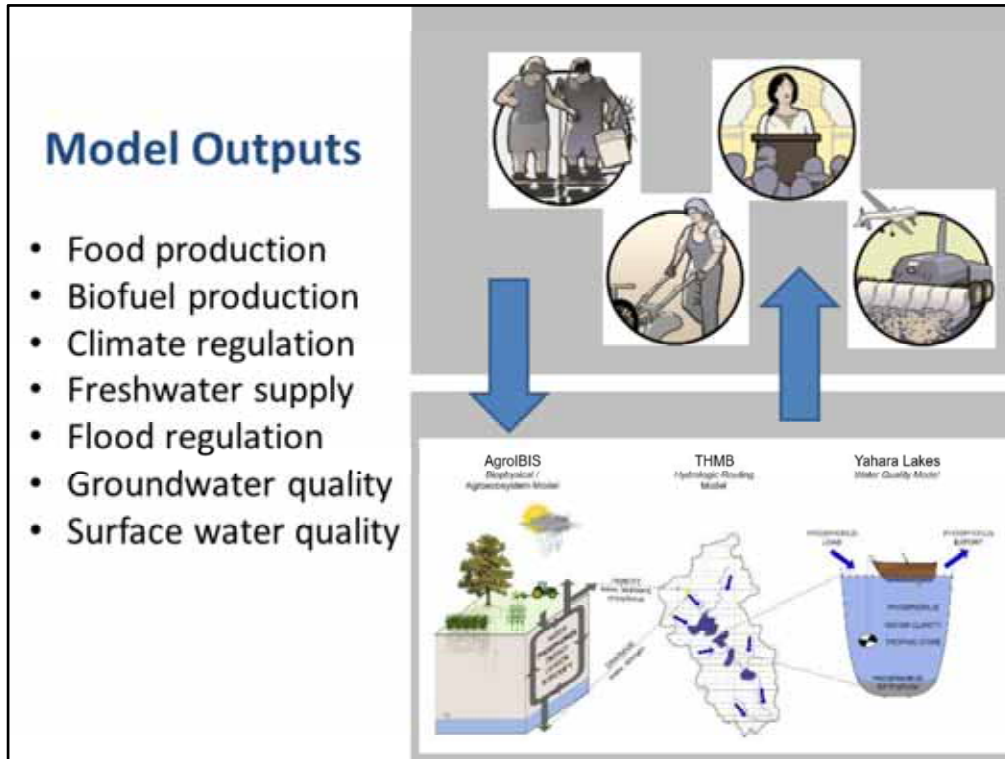
These maps show how the landscape changes in Nested Watersheds, as an example.

## The “Atoms” = Nutrient Management Changes

- Diet drives animal numbers (impacts manure inputs)
- Policies/values drive fertilizer rates



The nutrients come from livestock and fertilizer. The amount applied to the landscape depends on how food consumption / diet changes in the future. Fertilizer rates are dependent on policy changes. Generally, P inputs decline in all four



Once we have the stories, we can enrich them with the atoms, or the quantitative data about the future. The research team translated the stories into numbers that describe the land-use and climate changes that occur in each scenario.

## Stories + Atoms = Implications for future human well-being



Ultimately, the stories and atoms combined give us an idea of what human well-being could be like under each scenario.

It is important to remember that each scenario has pros and cons. There is no ideal, worst or best case scenario. There is also no “business as usual” scenario, as these are intended to help us think outside the box.

## Scenario Applications

- A tool to identify and prepare for vulnerabilities and ways to build resilience
- A framework for weighing tradeoffs and making choices
- A backdrop for priorities and the potential changes that could affect them
- An opportunity to engage people in transformative discussions about the future

Model results will provide tradeoff implications



Water quality management must deal with the soil P legacy and increasing precipitation for climate change – double whammy for water quality

Updated P budget – we're accumulating P even faster than we thought

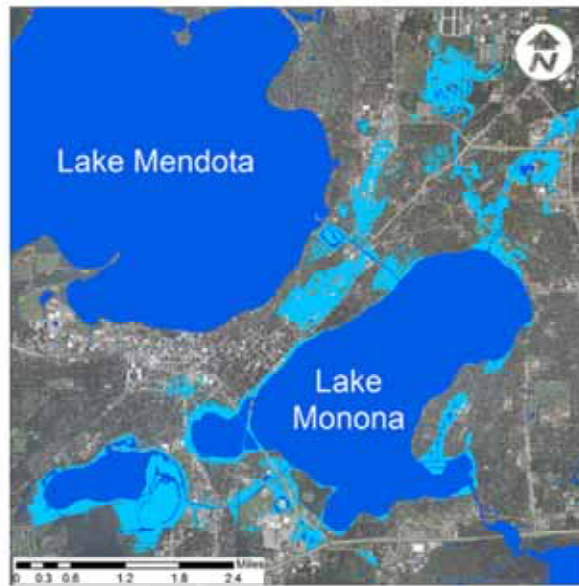
Consider environment in food choices

Large changes in landscape do not **automatically** and **immediately** lead to improved water quality

## Vulnerability and Resilience

Extreme flooding from climate change could create challenges for lake-level management and homeowners.

- Example from Abandonment & Renewal, 2031
- Similar to 2008 Lake Delton storm



Role of population increases and more urban development with impervious pavement. Not just our group – we are fairly susceptible to big flood risks



## Tradeoffs and Choices

Connected Communities



Accelerated Innovation



Nested Watersheds



Abandonment & Renewal



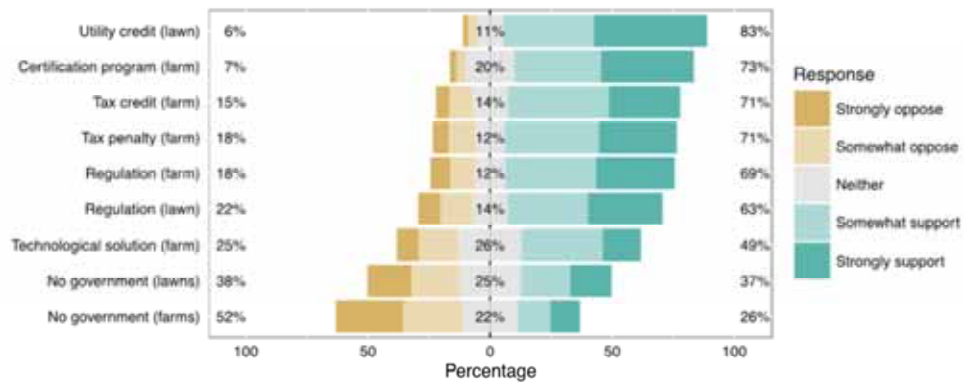
What do we want—or need—the watershed to provide?

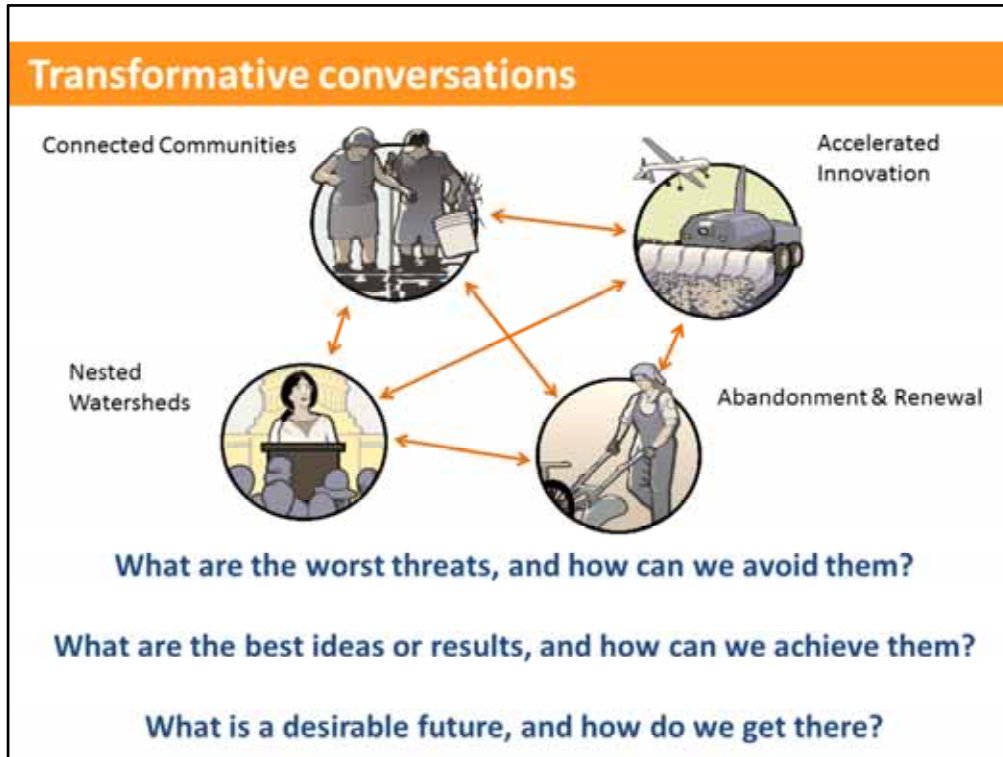
What is biophysically possible *and* socially acceptable?

What choices will allow us to handle shocks and build resilience?

## Backdrop for Priorities

People value clean water,  
and voluntary actions without government  
intervention are least favored





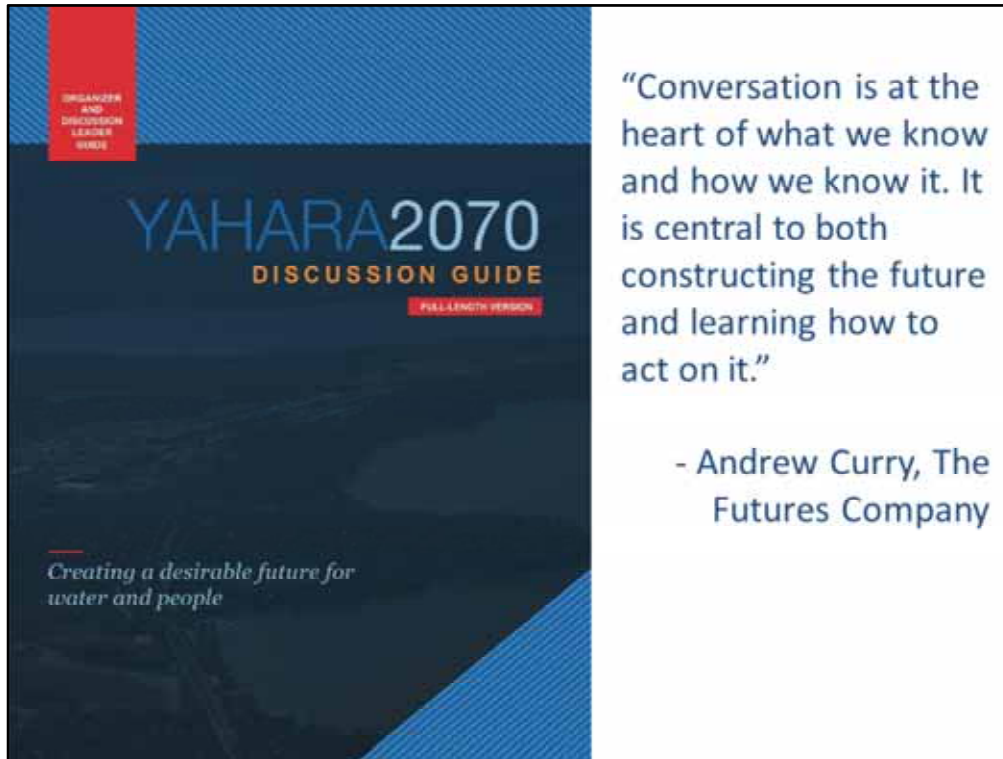
They also help us consider what we think is desirable or undesirable for the future, creating space for broad public discussion—space that we otherwise don't normally have in our daily lives.

## Transformative conversations



“If you want to build a ship, don’t start with collecting wood, cutting the plank and assigning work, but awake in people the longing for the wide and open sea.”

– Antoine de Saint-Exupery (*Citadelle*)



In-person communication is most powerful  
Building relationships is necessary for successful efforts  
Elaborate exploration of a concept key to sustained learning



**Goals**

- Create space for long-term thinking
- Connect people to develop a vision
- Stimulate imagination for transformative solutions
- Empower

In-person communication is most powerful

Building relationships is necessary for successful efforts

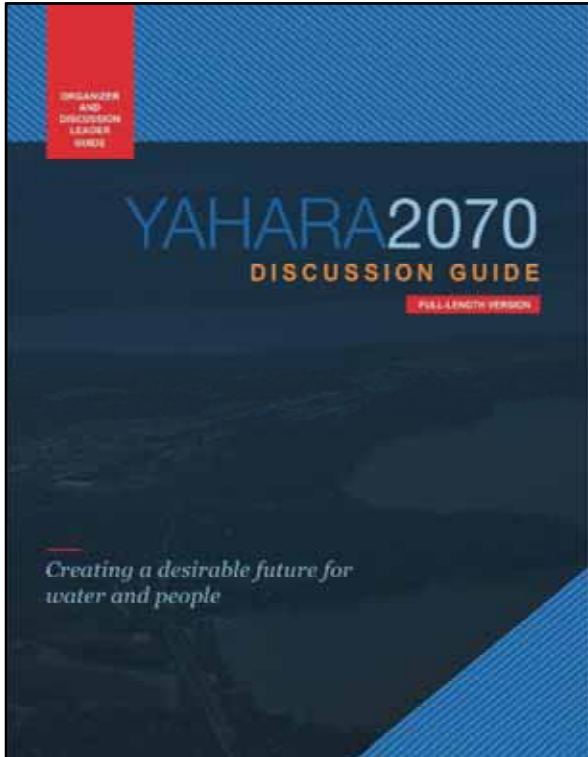
Elaborate exploration of a concept key to sustained learning

ORGANIZER  
AND  
DISCUSSION  
LEADER  
GUIDE

**YAHARA2070**  
DISCUSSION GUIDE  
FULL LENGTH VERSION

*Creating a desirable future for  
water and people*

Download the  
guides here:  
**wsc.limnology.wisc.edu/yahara2070/discussion-guides**



A. What does resilience mean to you?

B. What new, transformative ideas do you think are needed to build resilience?

C. What bright spots should we maintain and carry forward?

D. What ideas or practices should we leave behind?

**Sample question, Introduction:** The scenarios are meant to help us discuss how to build a resilient and desirable future for water and people. **Building resilience** involves coming up with new, transformative ideas for solving the challenges we face today. It also requires us to identify the great ideas and qualities we already have, or humanity’s “**bright spots**,” that we should carry with us into the future, while also considering the ideas we want to leave behind. Answer the following questions in the context of building a resilient and desirable future for water and people.



“We are called to be architects of the future, not its victims.”

– Buckminster Fuller

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## Wrap up

What could be the **challenges** of and **opportunities** to applying scenarios and systems thinking in your communities?

How might scenarios and systems thinking make a shift in your communities?