SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

Social Considerations about Water Conservation

Steve Conrad, November 29, 2016

The answer to BC's water supply issues is…

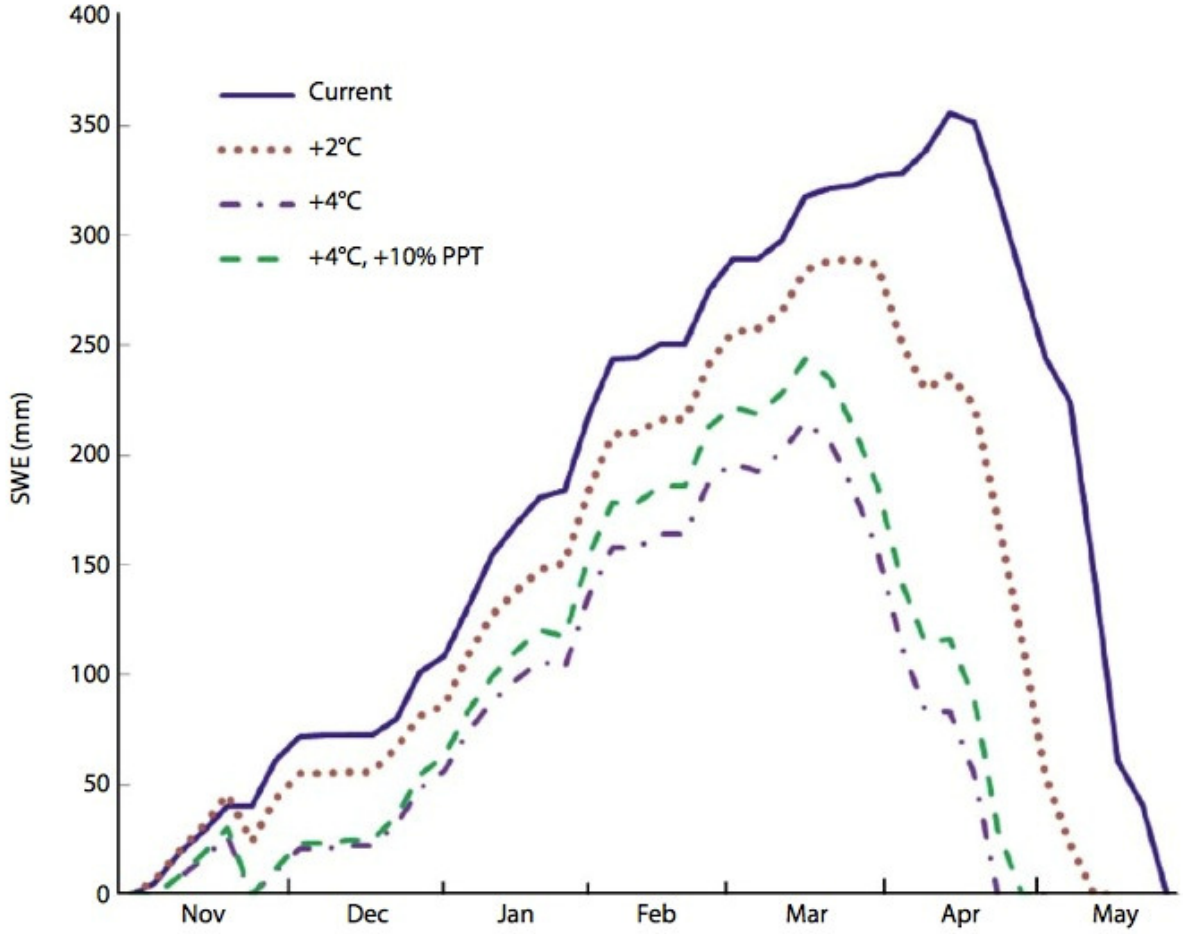
shore of Eagle Lake, 2015

The answer to BC's water supply issues is…

Photo retrieved from: www.commondreams.org

Groundwater

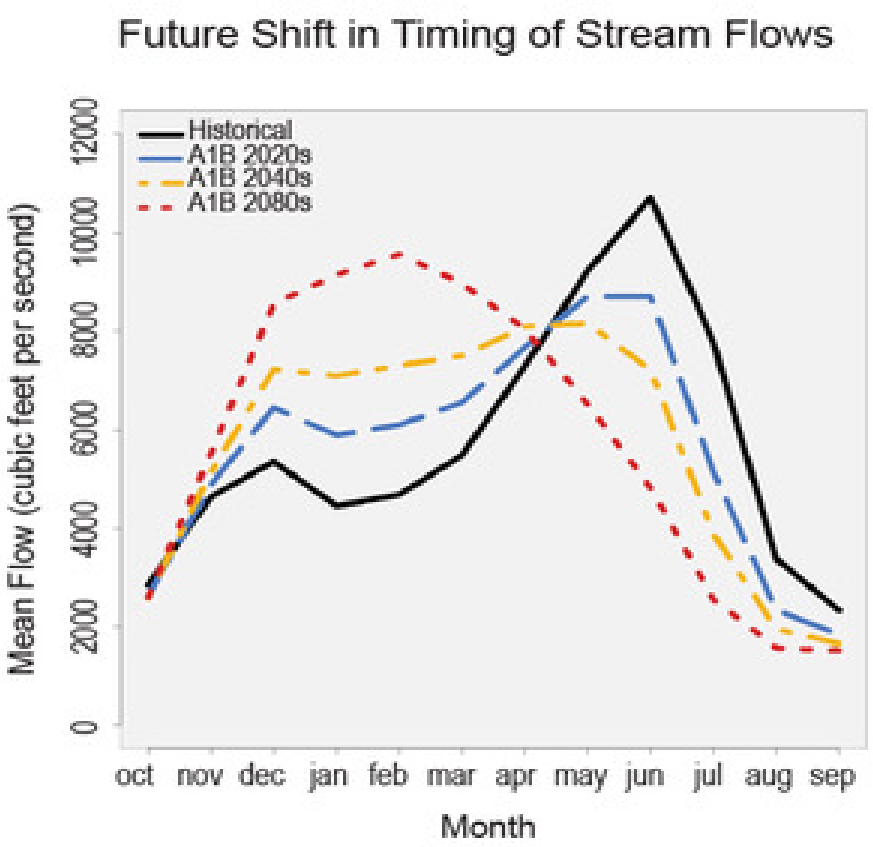
But seriously, if water demand continues to increase and water sources continue to decline...

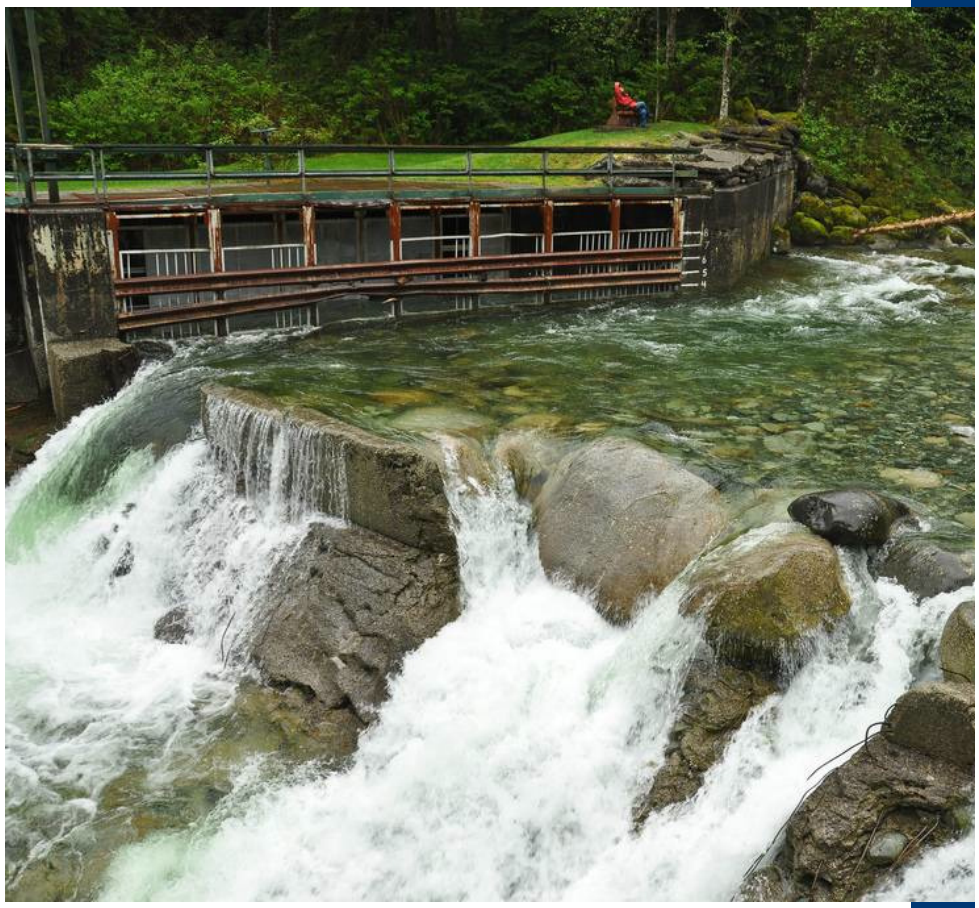


Source: Beaudry et al, 2010

Simulated winter snow water equivalent (SWE) in the mature lodgepole pine forest at the Upper Penticton Creek Experimental Watershed against climate forecasts

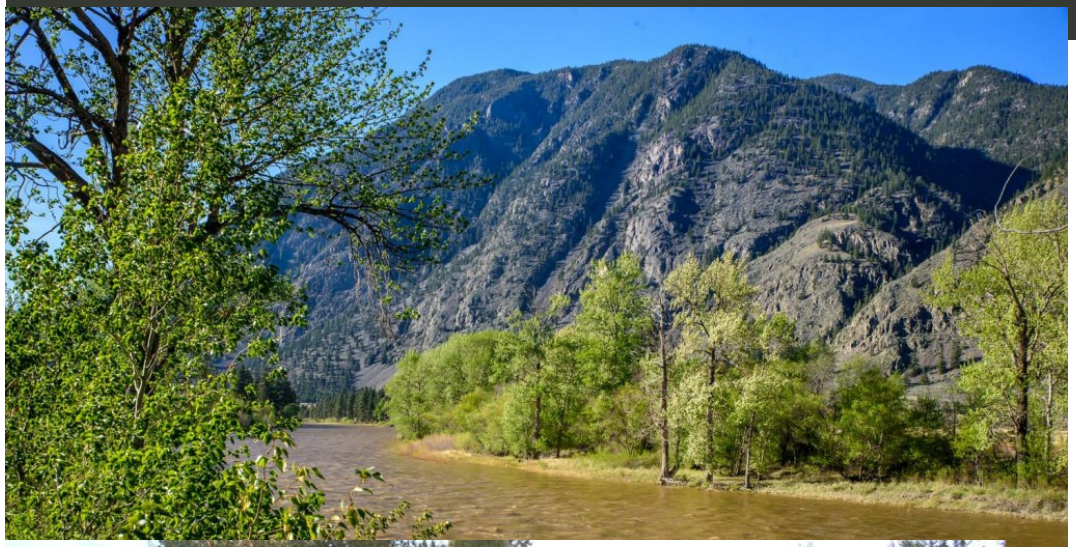
and river flows shift…





Source Elsner et al, 2010

can we manage water variability with human behaviour?



LOCAL NEWS \\

Okanagan creeks running high and fast

Posted on 4/19/2016 12:59 PM by Harry Callaghan

The record heat is causing a rapid snowmelt in the Okanagan.

David Campbell, at the BC River Forecast Centre, says there's evic creek levels have risen in Kelowna.

"Right now it's very much the smaller creek systems that are runn the big river systems, which take a bit longer to fill up and fill that smaller systems have really shown a response over the last two da

Campbell says the risk of flooding in the Okanagan has increased and they've already issued a warning about higher water levels in Okanagan Lake.

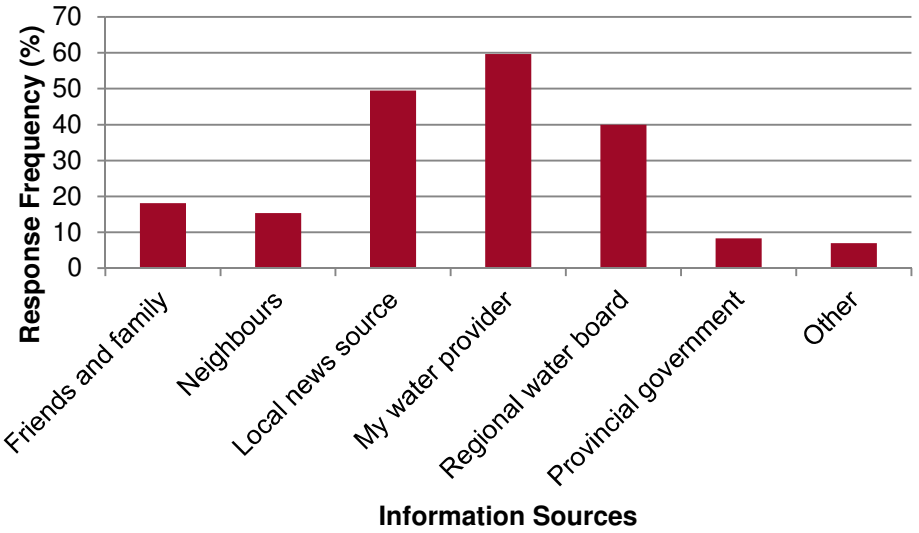
First, understanding the human factor…

- Water use is driven by
  - Knowledge
  - Social Norms
  - Preferences
  - Habits
  - Economic Factors

Okanagan's knowledge of water use

On water use

- confident in their ability to reduce indoor and outdoor water use, more confident in reducing outdoor water use than indoor, but less confident in identifying how much water is used
- Trust local water providers, news sources, and regional water boards



Conrad, S.A., 2012. Assessing the effectiveness of climate change adaptation policies: a survey of residential preferences (No. OBWB 11-010). Simon Fraser University, Natural Resources Canada, Burnaby, BC.

Despite lack of knowledge, Kelowna Residents willing to reduce water

To manage short term water scarcity respondents

- Respondents were willing to reduce their water use by an average of 44.2%

	No Reduction								Stop this activity				
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	$\bar{X}$	N
Summer lawn watering	2.5	2.8	8.3	13.7	7.7	25.8	6.3	8.8	9.6	4.4	10.1	**53.66**	636
Length of showering or bathing	9.9	7.3	11.5	13.5	5.2	25.8	6.1	10.1	6.0	3.2	1.4	41.85	784
Frequency of flushing toilets	17.0	6.4	9.8	13.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Frequency of using a dishwasher	11.5	5.5	9.8	11.6	[illegible]	18.2	4.7	10.2	6.8	3.3	13.0	48.64	782
Frequency of using a clothes washer	13.4	7.6	14.0	11.6	5.5	22.2	4.6	10.1	6.8	2.8	1.5	39.57	785
Sample MEAN ($\bar{X}$)												**44.20**	

53.6% reduction in lawn watering

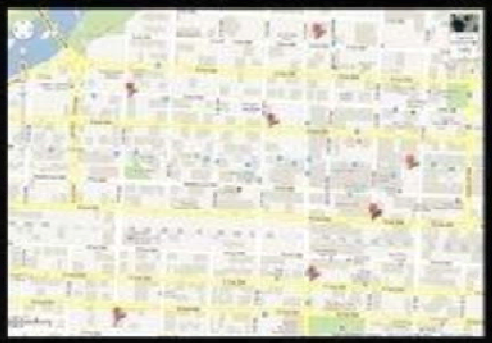
reducing water for personal care (clothes washing, flushing toilets, and showering and bathing) was less preferred.

Conrad, S.A., 2012. Assessing the effectiveness of climate change adaptation policies: a survey of residential preferences (No. OBWB 11-010). Simon Fraser University, Natural Resources Canada, Burnaby, BC.

SOCIAL NORMS

What my friends think I do

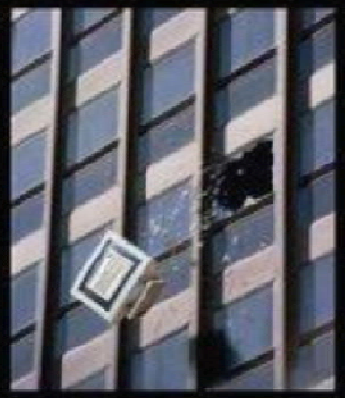
What my mom thinks I do



What society thinks I do

What my clients think I do

What I think I do



What I really do

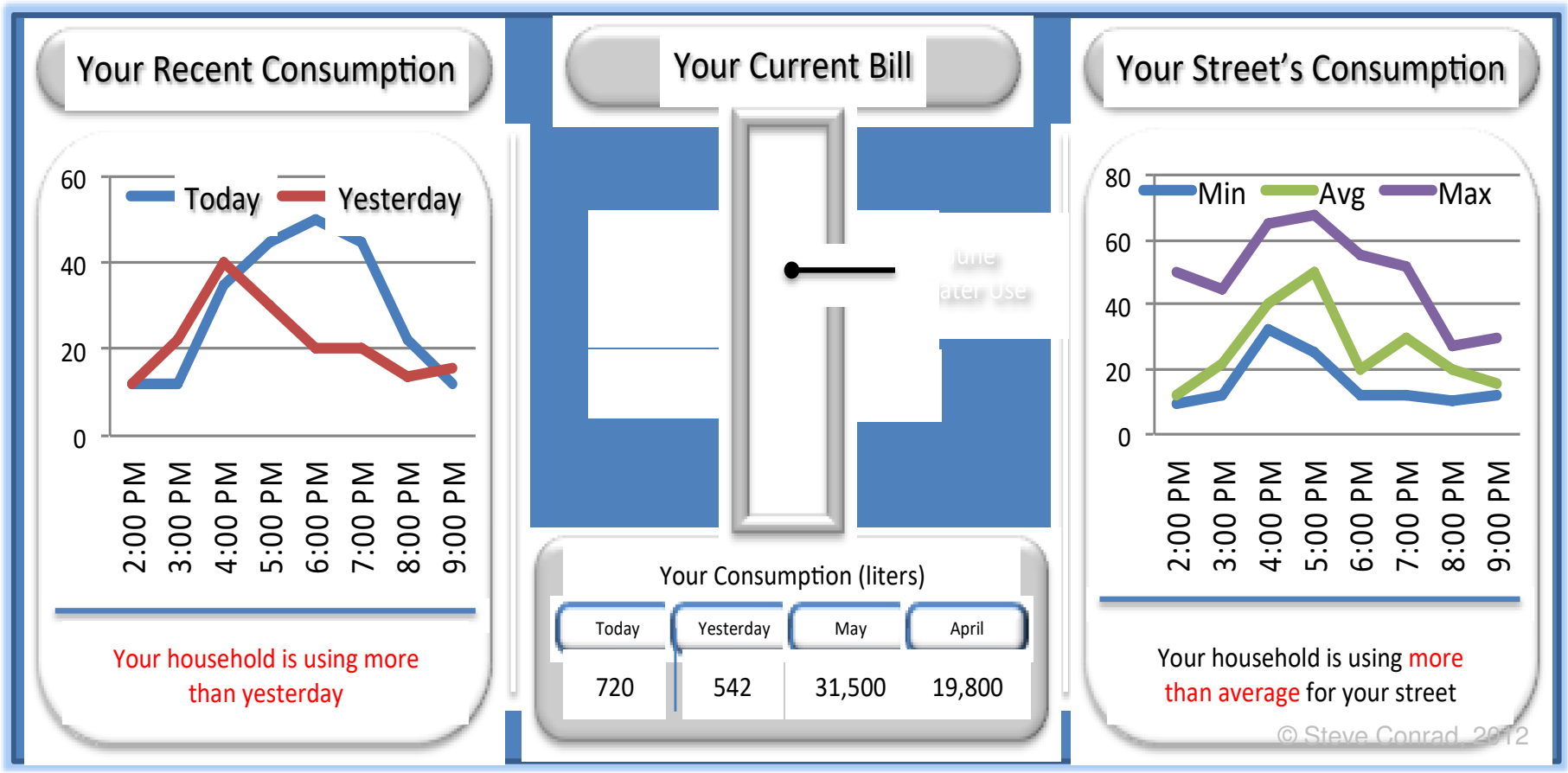
Do residents care what their neighbours think?

only 10.3% of respondents feel their neighbours would not accept changes in their landscape that reduced the amount of lawn.

Possible acceptance for changing landscapes

Conrad, S.A., 2012. Assessing the effectiveness of climate change adaptation policies: a survey of residential preferences (No. OBWB 11-010). Simon Fraser University, Natural Resources Canada, Burnaby, BC.

Social Norms and Knowledge (smart information) experiment

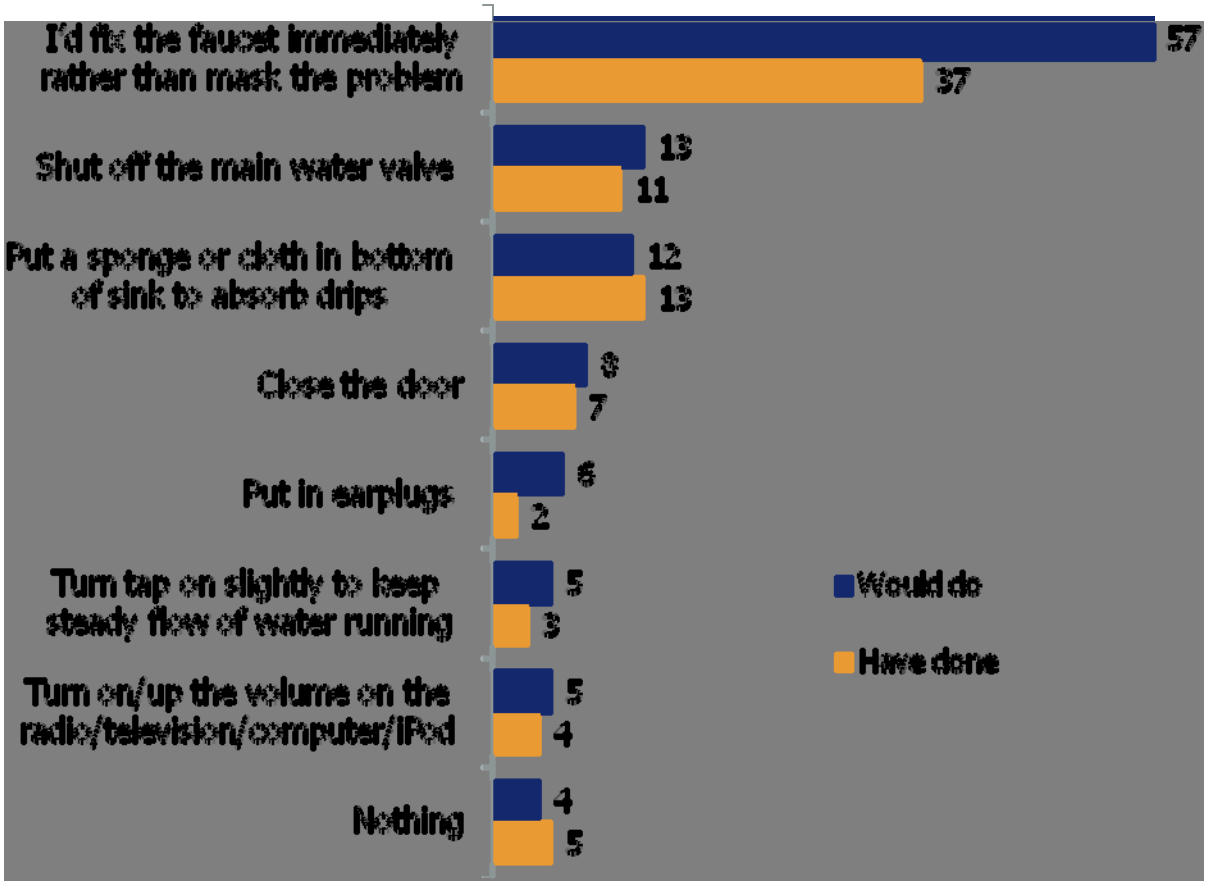


Conrad, S.A., 2012. Assessing the effectiveness of climate change adaptation policies: a survey of residential preferences (No. OBWB 11-010). Simon Fraser University, Natural Resources Canada, Burnaby, BC.

Effect of social norms

- Savings equivalent to increasing water price by 14% - 15%
- Residents more likely to participate in home survey/water audit and a toilet rebate
- Less likely to purchase new appliances, invest in technology

Actions Respondents "Would Do" / "Have Done" to Mask Sound of Leaky Faucet, 2014



While Canadians say they are likely to fix a leaky faucet immediately, far fewer actually do.

2014 *n*=2,074
Say you had a leaky faucet dripping into the bathroom or kitchen sink that you had not repaired, what would you do / have you done to mask the dripping sound?

2014 RBC Canadian Water Attitudes Study

Landscape preferences affecting water use…

Neighbour A

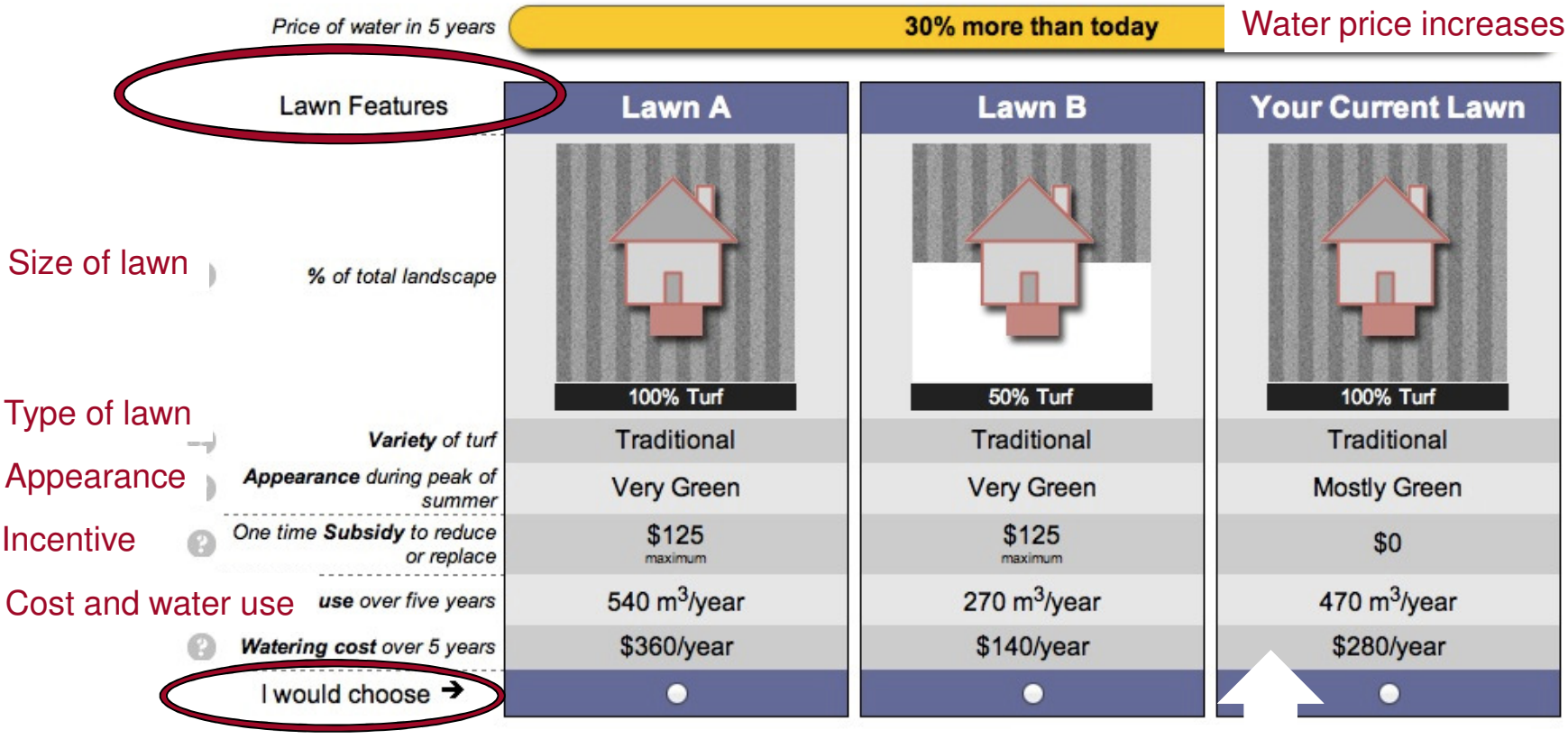
Neighbour B?

Neighbour C?

All photos by author, same neighbourhood, Kelowna 9/2012

How might water users respond to future lawn choices?

- **If the following were the only lawn options available to you, which one would you choose? ***
  Please make your choice by clicking on one of the profiles.



Water use and price estimated based on their current lawn and lawn choices A and B

Kelowna Residential Lawn landscape preferences

Results suggest a dislike for small and very large lawn sizes

Lawn replacement subsidies do not appear to be significant - At least at $125,$250,$375,$500

- Key Observations
  - 50% turf most acceptable for residents
  - Residents with 75% turf supported choosing 25% turf options*
  - Residents with 25% turf sizes were less likely to choose alternative lawn options regardless of lawn features

** Yet, a large portion of residents with medium and large lawns believed that they do not have the time to retrofit their yard to increase water efficiency*

Significant water savings possible through landscape policies

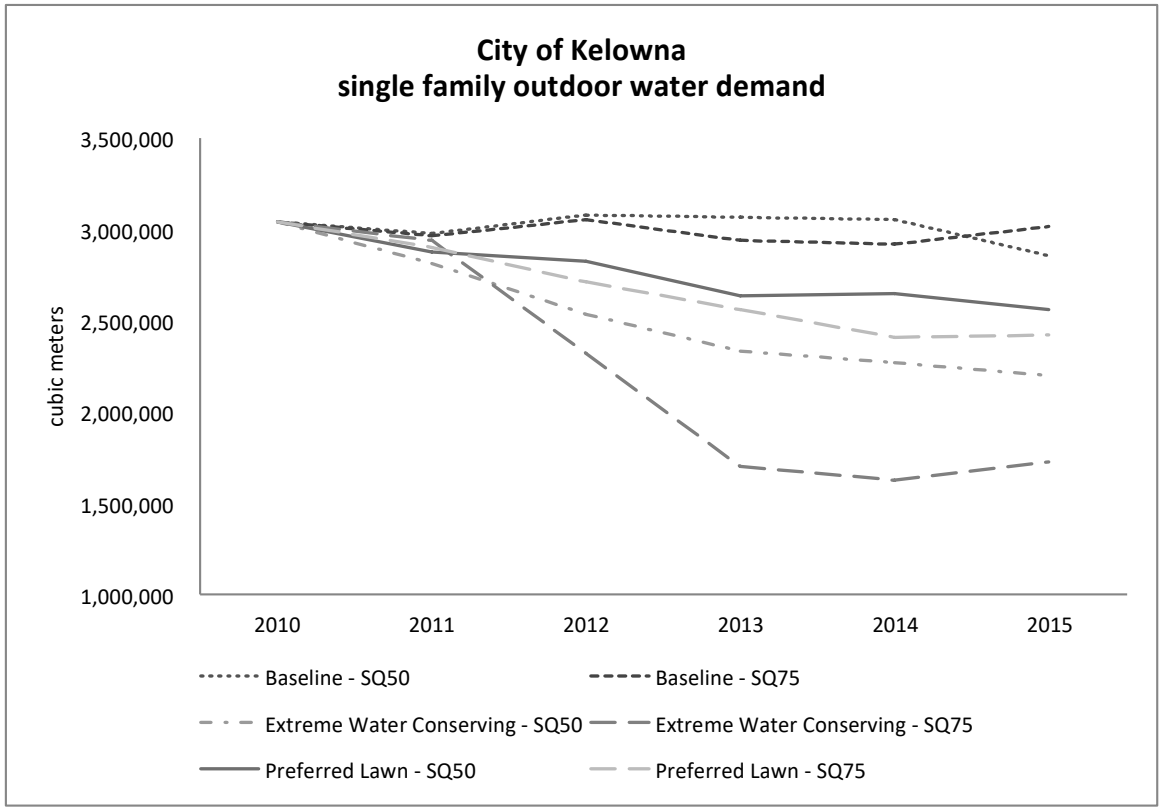


Fig. 4.6. Single family outdoor water demand under the *Baseline*, *Extreme Water Conserving*, *and Preferred Lawn* scenarios during the period 2010–2015 for SQ50 and SQ75 status quo configurations

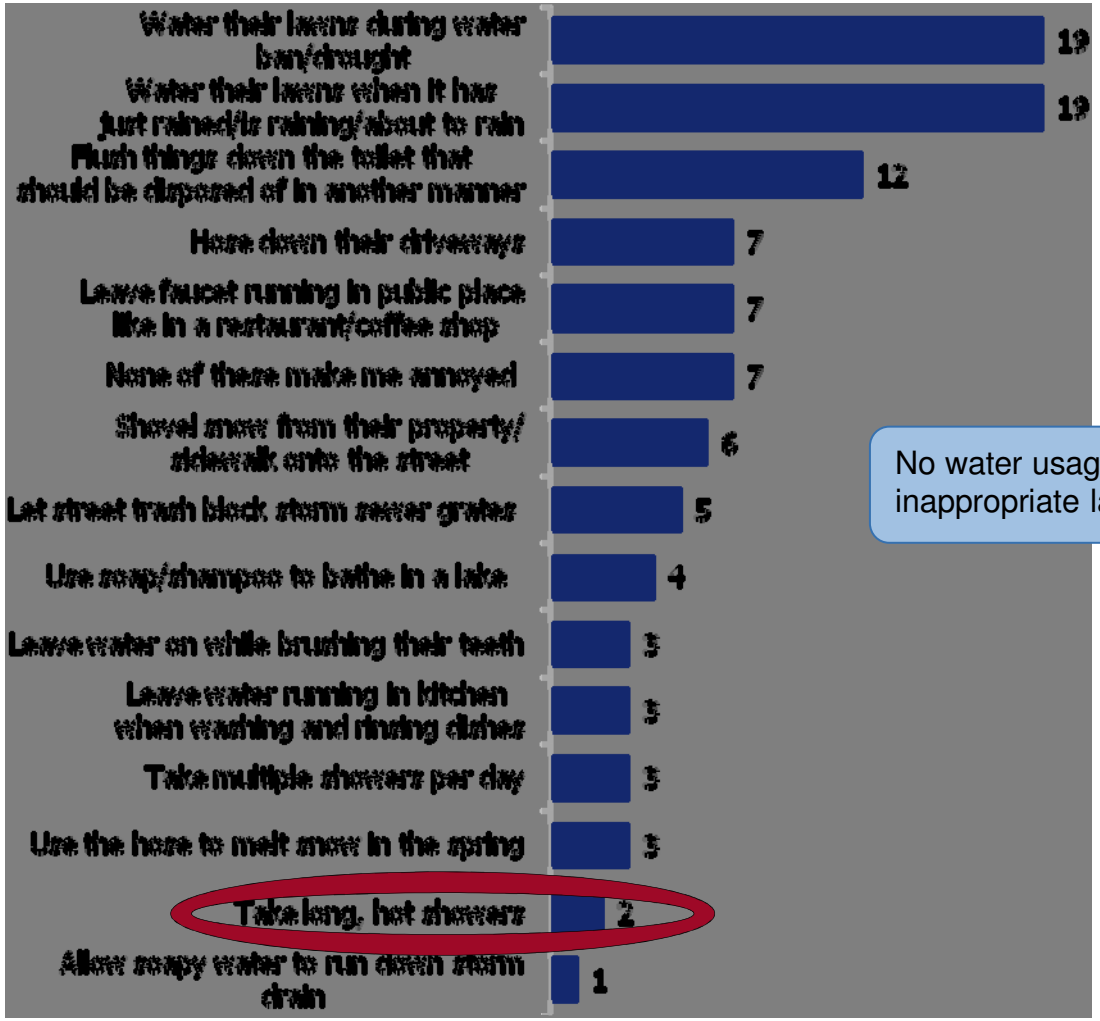
Conrad, S. and Yates, D., (in press) "Coupling stated preferences with a hydrological water resource model to inform water policies for residential areas in the Okanagan Basin, Canada." *Journal of Hydrology*

as long as lawns stay green

But even during water shortages…

- a large portion of respondents (>47%) indicated that they would find “brown” public green spaces “disturbing” and
- a **larger** portion of respondents (>51%) indicated that they would find “brown” private green spaces “disturbing.”

Top-of-Mind Most Annoying Water Usage-Related Activities, "When People…," 2014



Habits matter…

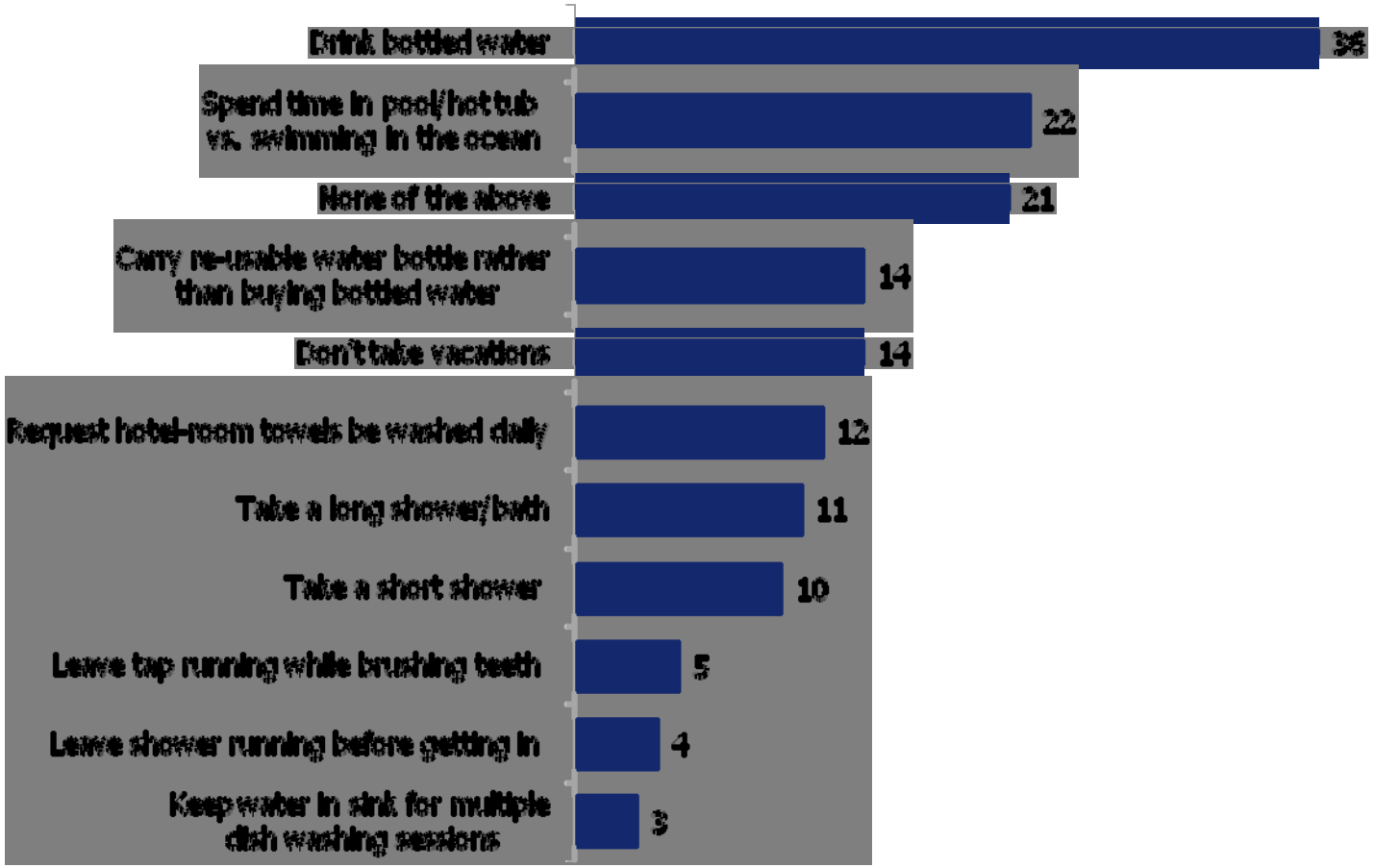
No water usage activity annoys Canadians more than inappropriate lawn watering.

All respondents, 2014 *n*=2,074

Which of the following activities, if any, annoys you the most? When people. . .

2014 RBC Canadian Water Attitudes Study

Changes in Water Use While on Vacation, 2014



Other than buying more bottled water, Canadians' water use habits do not tend to be any worse while on vacation.

2014 *n*=2,074

Thinking of how you use water do at home?

Which, if any, of the following do you do while on vacation but don't usually

2014 RBC Canadian Water Attitudes Study

MAKE YOUR BODY HAPPY
$5.25*
Charges will be applied to your room bill at checkout.
AQUAFINA
MAKE YOUR BODY HAPPY
$5.25*
Charges will be applied to your room bill at checkout.
AQUAFINA
(c) Steve Conrad, 2011

FOUR SEASONS
RESORT AND RESIDENCES
Whistler
6.00 $
drink up
A charge will be added to your account upon consumption.
evian
© Steve Conrad, 2015

Comments on Agricultural Water Use

Resistance toward water management efforts

- *"I'm already doing everything I can to save water and yet I keep getting asked to buy some new technology or do something different with how I water my crops."*

Worry toward losing water rights

- *"I have 25 acres I could farm but it's already difficult enough to farm 15 acres. I pay licenses for all 25 but what happens if we run out of water when I'm not farming the other 10? Will someone take it back or will the water be there for my children?"*

Conrad, S.A., 2013. Assessing Water Use Preferences to Water Conservation Policy and Implementation Strategies. Simon Fraser University, Investment Agriculture Foundation of British Columbia, Victoria, BC.

Comments on Agricultural Water Use

Water conservation vs. water efficiency

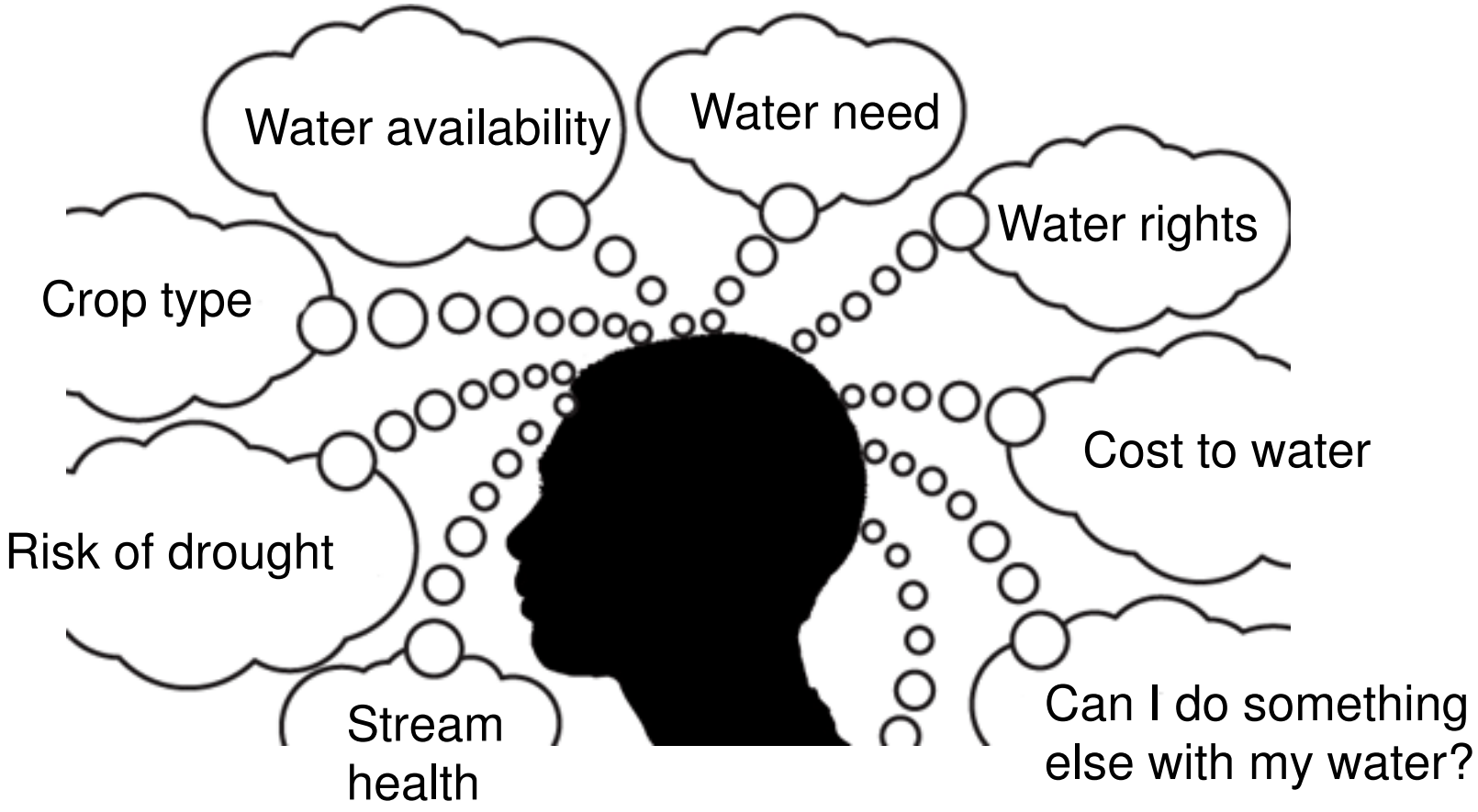
- *"If I use less water one year then someone [referring to water managers] might tell me I don't need as much water next year. I don't waste water but I use what I've licensed so I have enough water for next season."*

Water trading

- *"I have priority on the stream but the last time there was a drought I was asked by [name withheld] downstream to cut back on watering so he could pull water from the stream so he could harvest. I cut back and we worked out a deal to share the receipts."*

Conrad, S.A., 2013. Assessing Water Use Preferences to Water Conservation Policy and Implementation Strategies. Simon Fraser University, Investment Agriculture Foundation of British Columbia, Victoria, BC.

Farmer irrigation decisions during water shortages…

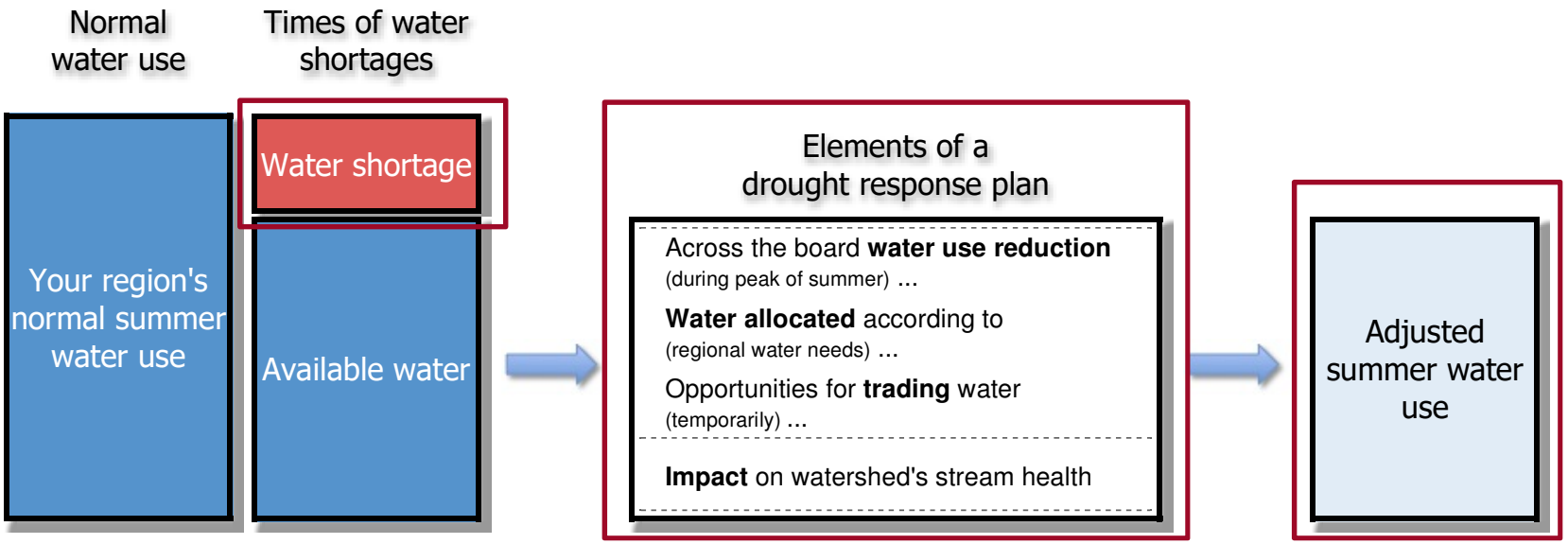


How should your region plan for water shortages?

Currently, the BC government proposes to give regional water users more flexibility to develop their own drought response plans for times when their water requirements can no longer be met.

Imagine that you are working with a group of other farmers in your region to develop such a drought response plan.

The diagram below illustrates how a drought response plan will address a water shortage to reduce the amount of water used and also considers the health of the environment.

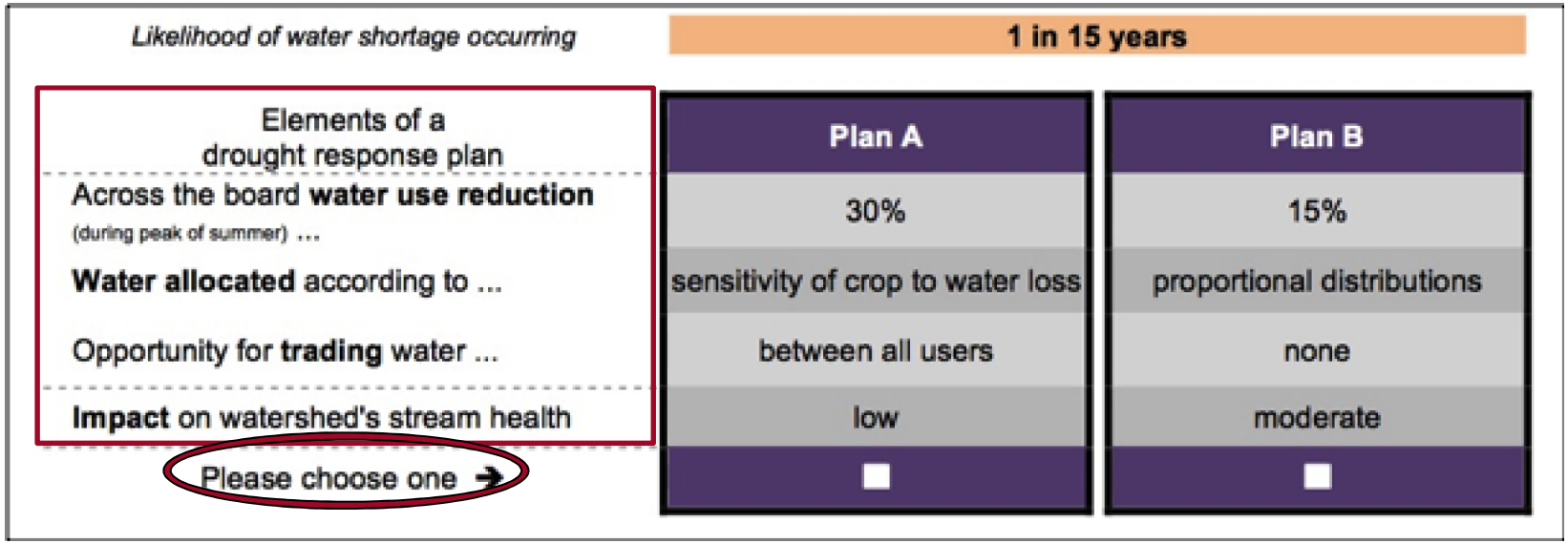


*In the next section of this survey, you will be presented with **several possible drought response plans**.*

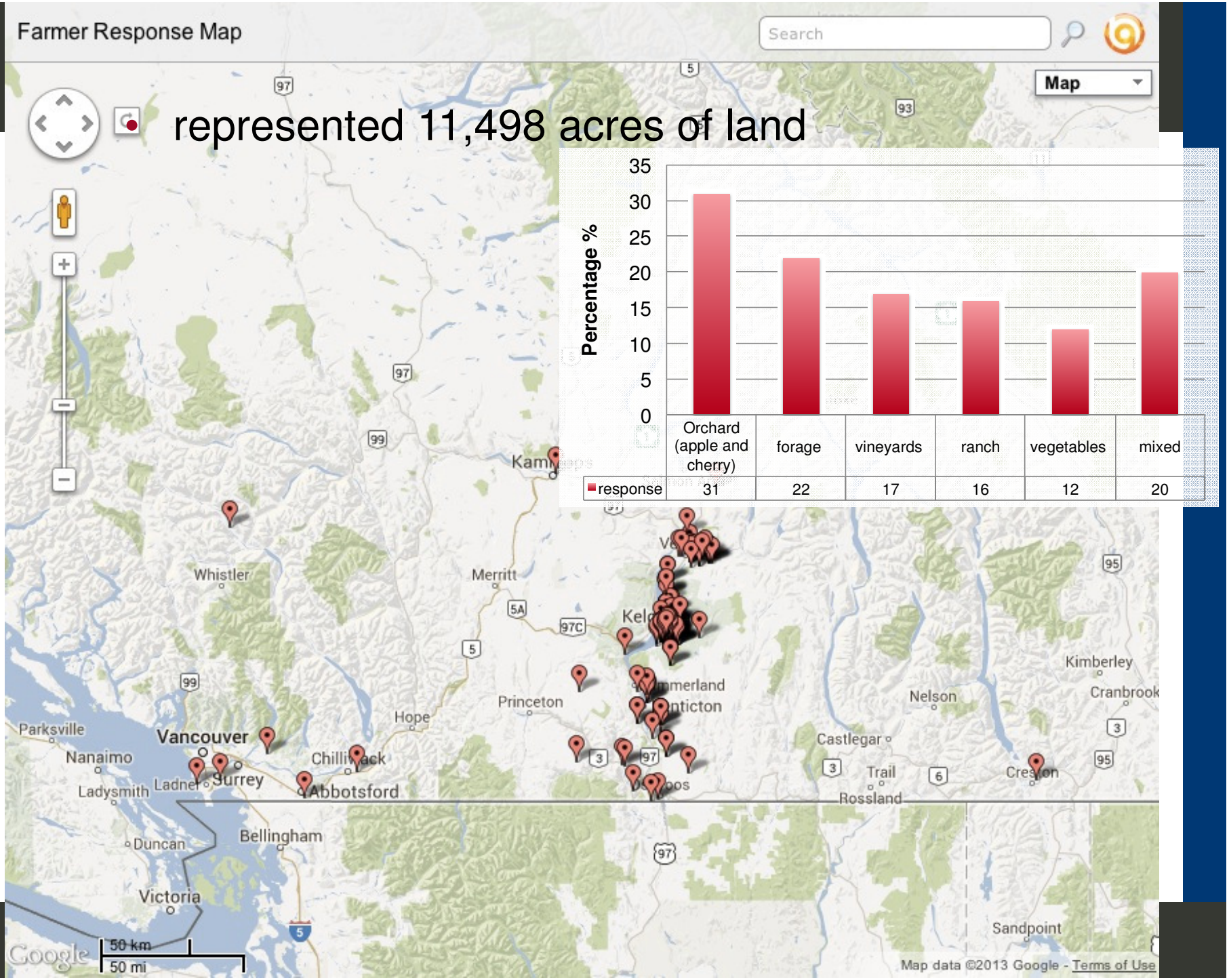
*See next page for **an example**.*

Next >>

An example choice set

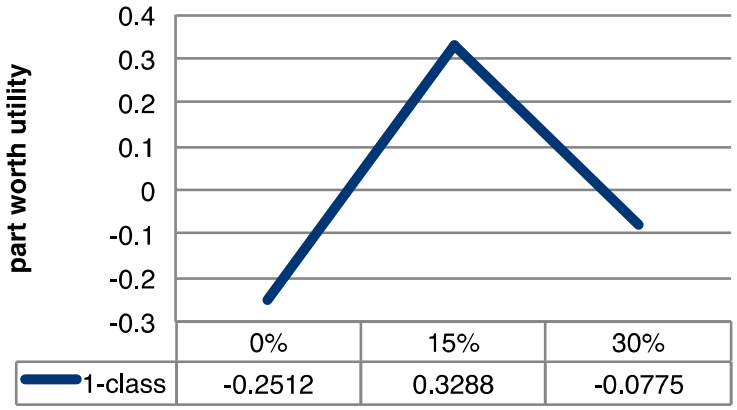


Likelihood of water shortage occurring	**1 in 15 years**	
Elements of a drought response plan	**Plan A**	**Plan B**
Across the board **water use reduction** (during peak of summer) …	30%	15%
Water allocated according to …	sensitivity of crop to water loss	proportional distributions
Opportunity for **trading** water …	between all users	none
Impact on watershed's stream health	low	moderate
Please choose one →	☐	☐

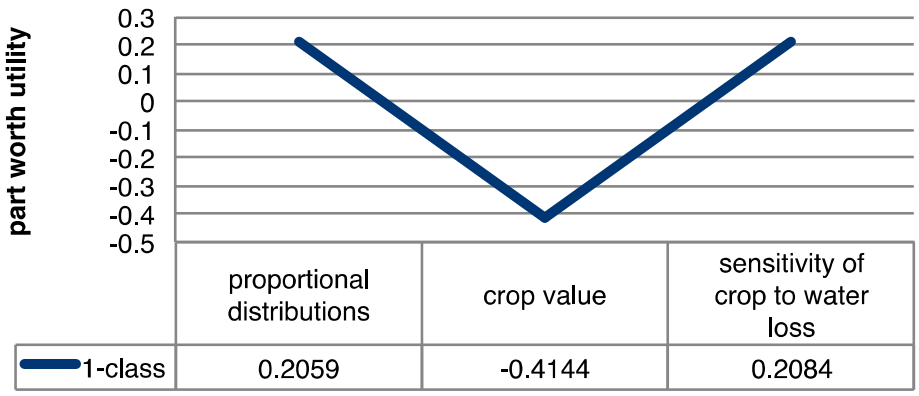

Farmer Response Map
Search
Map
represented 11,498 acres of land
Percentage %
35
30
25
20
15
10
5
0
Orchard (apple and cherry)
forage
vineyards
ranch
vegetables
mixed
response
31
22
17
16
12
20
Whistler
Merritt
Princeton
Hope
Vancouver
Surrey
Abbotsford
Chilliwack
Nanaimo
Parksville
Ladysmith
Duncan
Victoria
Bellingham
Nelson
Castlegar
Trail
Rossland
Kimberley
Cranbrook
Sandpoint
50 km
50 mi
Google
Map data ©2013 Google - Terms of Use

Results for entire farm population show willingness to consider alternative allocation policies

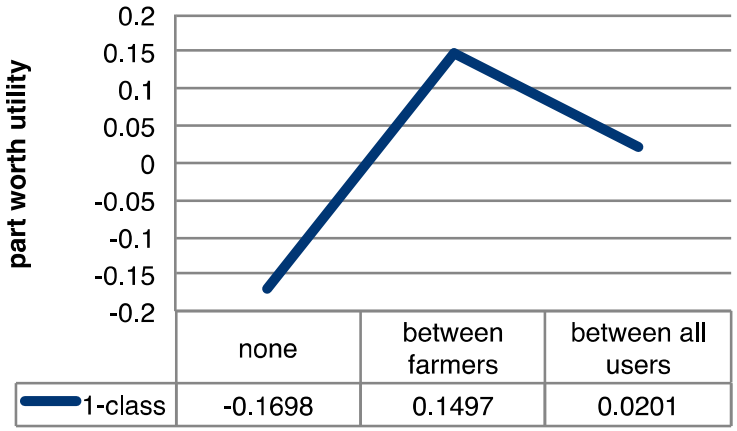
mandated reductions



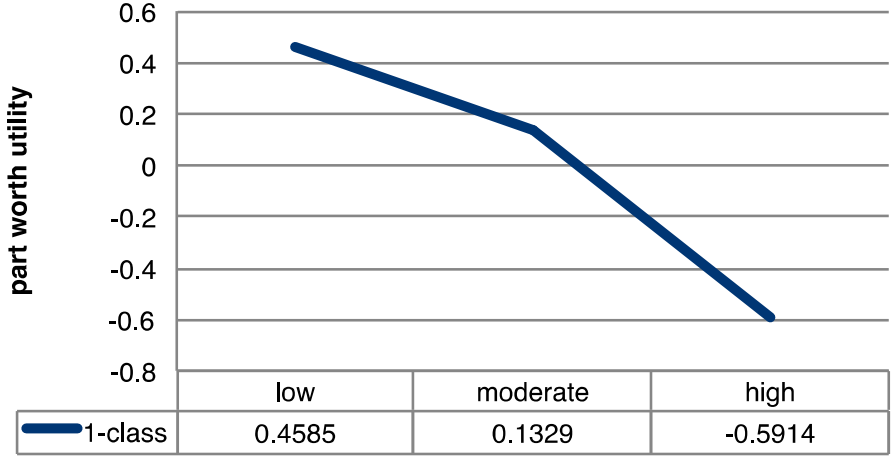
allocation priorities



trading opportunities



environmental impacts



Source: Conrad, SA, Rutherford, M, Haider, W., (in review)

Results suggests that farmer preferences differ by farm type

Table 3.3 **Results of the 'known class' multinomial logit model testing effects of drought response plan elements[a]**

Attribute and Attribute Level	Forage		Orchards		Vineyards		Ranches		Mixed	
	Estimate	(s.e.)[b]	Estimate	(s.e.)[b]	Estimate	(s.e.)[b]	Estimate	(s.e.)[b]	Estimate	(s.e.)[b]
Opportunities for trading water										
None	-0.3693	0.1621**	-0.2845	0.1438**	-0.3497	0.1727**	-0.2478	0.1919	-0.0469	0.1339
Yes - Between farmers	-0.1556	0.1691	-0.1614	0.1377	-0.3769	0.2064*	0.5005	0.1981**	-0.1815	0.1336
Yes - Between all users	-0.0703	0.1721	0.0231	0.1265	0.6266	0.1862***	-0.2527	0.2000	0.2284	0.1422
Across the board reduction										
None (0%)	-0.2735	0.0803***	-0.2735	0.0803***	0.0286	0.1764	-0.4522	0.2046**	-0.2735	0.0803***
Yes- 15% reduction	0.4253	0.0806***	0.4253	0.0806***	0.1015	0.1957	0.4253	0.0806***		
Yes - 30% reduction	-0.1518	0.0800*	-0.1518	0.0800*	-0.2423	0.1766	0.3508	0.1988*	-0.1518	0.0800*
Water allocated according to										
Proportional distributions	0.2283	0.0668***	0.2283	0.0668***	0.2283	0.0668***	0.2283	0.0668***	0.2283	0.0668***
Crop Value	-0.4474	0.0710***	-0.4474	0.0710***	-0.4474	0.0710***	-0.4474	0.0710***	-0.4474	0.0710***
Sensitivity of crop to water loss	0.2191	0.0680***	0.2191	0.0680***	0.2191	0.0680***	0.2191	0.0680***	0.2191	0.0680***
Impact on watershed's stream health										
Low	0.4358	0.0689***	0.4358	0.0689***	0.4358	0.0689***	0.4358	0.0689***	0.4358	0.0689***
Moderate	0.1745	0.0685**	0.1745	0.0685**	0.1745	0.0685**	0.1745	0.0685**	0.1745	0.0685**
High	-0.6030	0.0708***	-0.6030	0.0708***	-0.6030	0.0708***	-0.6030	0.0708***	-0.6030	0.0708***

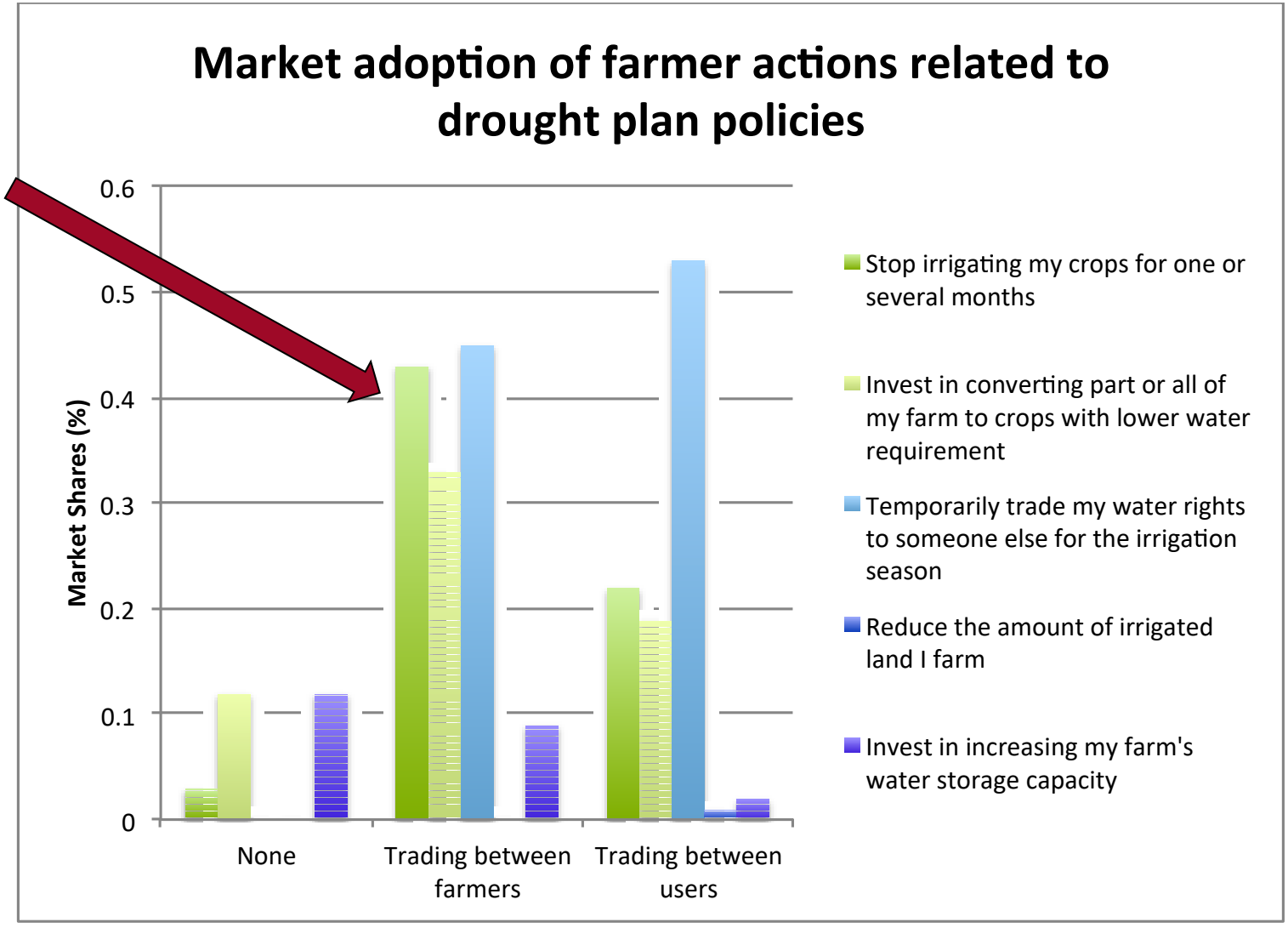
[a] Rho²=0.1659; The consolidated model, indicated by □ , is more statistically parsimonious; Known class segmentation presents smaller sample sizes for model estimations resulting in increased standard error

[b] Standard Error *** Indicates significance at 1 % level, ** at 5 %, and * at 10 %

- Similar preferences for
  - Water allocation policies
  - Impacts on stream health
- Differences
  - Vineyards indifferent to water restrictions
  - Vineyards less likely to prefer trading between farmers vs. all users
  - Ranchers less likely to agree with no mandatory restrictions
  - Forage crop farmers less likely to prefer trading opportunities between all users

Source: Conrad, SA, Rutherford, M, Haider, W., (in review)

Estimating impact of policies (farmers as a single group)



Political and Management Action

- Contrast pre-study assumptions
  - that farmers oppose water reductions, water markets/trading
  - Findings
- Lawn size is a reasonable target for water conservation policies
- Providing site specific information (price, water use) to homeowners may encourage shifting to water conserving landscapes

Thank you…

Contact: steve_conrad@sfu.ca

What drives consumption down

1. Income
2. Prices
3. Preferences/Attitudes
   - Customer information (from research)
     - Technology messages (top tips)
       - Little effect
     - Appeal to social good
       - ~3% immediate reduction but wanes after 1 year
     - Compare to social norm
       - Continued reduction ~3%
     - Sub-metering conversion in apartment buildings (billing pass through) resulted in 30% reduction in water use
   - Underestimating savings
     - Perceptions of water use suffer from severe underestimates
     - Participants think curtailment activities are most effective rather than efficiency activities
4. Technologies (and their prices)
   - Household technologies
     - More water efficient new construction in conjunction with population growth was the single largest driver
   - Rebate programs
     - Tricky to assess when the behaviour (retrofit purchase) naturally occurs.
     - Need to measure ***additionality***.
     - 63% of savings occur outside of rebate programs (Taylor, 2013)
       - Better target Multi-family/commercial/industrial
5. Prescriptive demand management
   - Outdoor water use
     - Price and neighbour's landscape influence residential landscapes