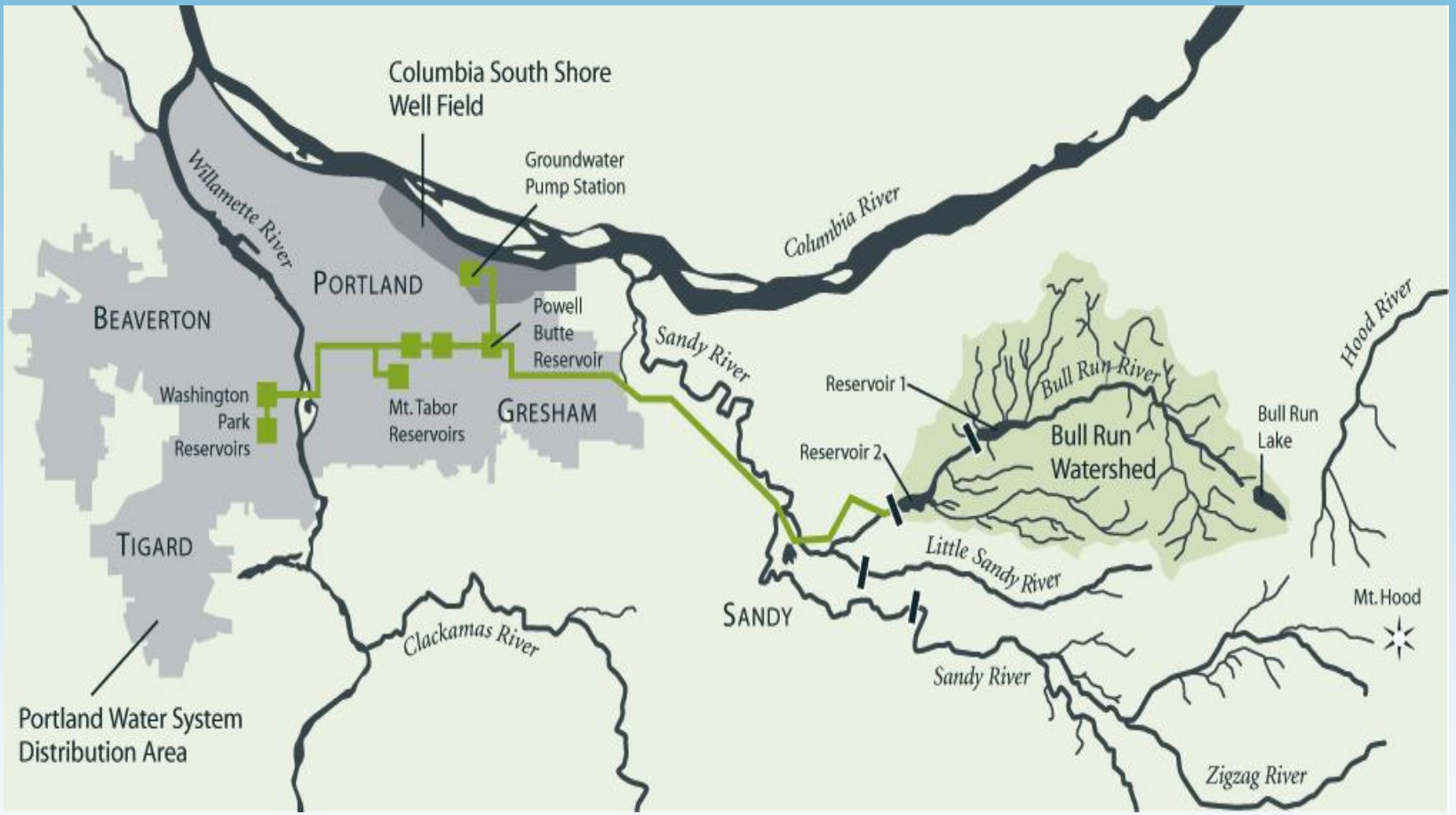
Evaluating Water Savings from Device Distribution

Sarah Murphy Santner
Water Conservation Program Coordinator

Portland Water Bureau
Portland, Oregon

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Portland's Water System



PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Bull Run Watershed
Harvesting Rainwater Since 1895

- **Ample Seasonal Rainfall.**
  - Bull Run: 138 in of average rainfall with some areas as high as 170 inches/year.
- **Excellent water quality.**
  - No development
  - No glacial melt
- **Gravity Flow from source to the city.**
  - Over 80% of the system is gravity flow
- **Protected watershed.**
  - 102 square mile drainage,
  - Protected by federal law, restricted access
  - Jointly managed by the US Forest Service and the Portland Water Bureau.
- **Limited Storage**
  - Dam No. 1 - Built in 1929 holds 9.9 billion gallons
  - Dam No. 2 - Built in 1962 holds 6.8 billion gallons

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Columbia South Shore Wellfield
Groundwater Supply

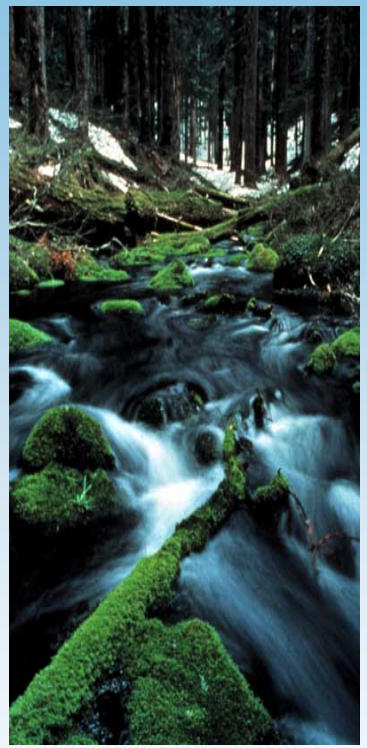
- Development began in 1975
- Used as a water source since 1985
- 100 MGD average
- Over 25 wells
- Active groundwater protection program in place.

GROUNDWATER PROTECTION AREA
COLUMBIA SOUTH SHORE

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Portland Water Usage (2007-2008)

- Total Population Served = 879,900
- Winter System Production = 85 MGD
- Summer System Production = 135 MGD (peak 180 MGD)
- Residential Per Person = 64 GPD
- Total Portland Usage = 20.9 BG
- Total Wholesale Usage = 14.6 BG (41%)



- **Carbon footprint**

  2007 = 0.38 MT of CO_2e per MG

  (1 cross country flight = 0.69 MT of CO_2e)

PORTLAND WATER BUREAU

FROM FOREST TO FAUCET

Portland's Water Future

- **Climate change:**
  - Water Bureau commissioned study in 2002 (U of W Climate Impacts Group)
  - More frequent extreme year scenarios, increased temperature, longer dry season
    - Increased demand for water
- **Population growth:**
  - Projections show regional increase population
    - Portland - not significant
    - Suburbs – more
- **Other factors:**
  - Per capita demand has gone down
  - Active regional development of alternative sources
  - Bull Run provides adequate supplies during winter
  - Summer peaks continue to be focus
- **Bottom Line:**
  - Current supplies adequate for next 30+ years

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Portland Conservation Programs

Portland conservation programs are customer-focused.

1. Business, Industry & Government programs
2. Residential Programs
3. Multifamily Programs

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Residential Device Distribution

- Portland Water Bureau has been distributing water conservation devices since 1992.
- Kits are distributed based on customer request – through the website, customer service call center, or conservation call center.
- Conservation staff track
  - Account number
  - Name and address
  - Request date
  - Items ordered (number of kits per customer)
- One of the devices available was called the "Bathroom kit"

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Portland's "Bathroom" Kit

- 1 toilet displacement bag (estimated savings of 1/2 gallon per flush)
- 1 fill cycle diverter (estimated savings of 1/2 gallon per flush)
- 1 bathroom faucet aerator (estimated savings of 1 gallon per minute)
- Cost per kit plus mailing and administrative overhead is $9.84
- Devices have an estimated 5 years saving life
- 2273 kits distributed between 2002 - 2005

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

The Study

- Purpose: Evaluation of (1) water savings and (2) cost-effectiveness of kits distributed between 2002-2005.
- Savings and cost-effectiveness relate to this program and its participants only, findings should not be generalized across the wider customer base.
- Initial study done in 2007 with a follow-up evaluation done in 2009

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Water Savings Analysis

- Total of 2,273 kits were distributed, based on request by SFR, MFR, and C&I
- Only SFR customers with available pre and post consumption data were considered
- 123 households met the criteria
- Average daily pre- and post- participation winter consumption was computed for each participant
- Paired t-test was conducted to detect difference in pre- and post-consumption

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Results of Water Savings Analysis

Paired t-Test results of Two Samples for Mean		
	Pre	*Post*
Winter Mean Daily Consumption (CF)	26.12	22.46
Variance	198.22	193.13
Observations (# of households)	123	123
Hypothesized Mean Difference	0	
df	122	
t Stat	4.0624	
P(T<=t) one-tail	0.0000	
t Critical one-tail	1.6574	

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Results of Water Savings Analysis

- Mean savings
  - Daily 3.7 CF
  - Annual 13.4 CCF
  - Annual 95% confidence range 6.9-19.9 CCF
- SFR mean annual consumption 89 CCF (2002-2005)
  - Savings amount to 15% of annual consumption

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Analyzing Cost-effectiveness

- Compute discounted annual water savings per participant over the 5-year saving life of the kit
- Compute average kit costs per participant
- Compute average cost per unit saved
- Cost-benefit analysis

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Results of Cost-effectiveness Analysis

- Average number of kits per household = 1.74
- Cost per kit (devices & shipping) = $9.84
- Present Value of Annual Water Savings = 61.19

- Program Cost per CCF Saved = $0.28
  (95% confidence range of ($0.19-$0.55))

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Cost-Benefit Analysis

- Three perspectives
  - Customer
    - Zero cost, lower bill
  - Utility
    - Cost of program, avoided costs
  - Societal
    - CB to customers, utility, and others

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

CB Analysis
(Utility perspective)

- Avoided costs in terms of postponing supply increments

- Marginal costs
  - don't have a good calculation

- Ground water costs (short-run supply)
  - $0.34/CCF vs. $0.28/CCF

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

2009 Updated Evaluation

- Have our customers sustained those savings during the past two years since our first analyses?
  - Out of 123 original accounts, 104 are still active.
  - Daily average consumption computed by dividing total winter consumption by the total days of service over 2006-2009 period.
  - Paired t-test conducted comparing pre- and post-participation average daily consumption of accounts from 2006-2009.
- Caveats:
  - Change in billing system in 2007
  - Went from tiered rates to flat rate

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

2009 Updated Evaluation Results

- T-test results showed <u>sustained lower average consumption</u> for participants.
  - Savings 5.08 CF/day (38 gallons);
  - Savings 18.3 CCF per year (13,688 gallons).
  - One-tail test shows t value of 4.31 and P(T<=t) of .0000185 (almost zero possibility for the average of the difference in pre- and post-consumptions to be zero.) More than likely due to other conservation measures.

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

ANALYSIS CONCLUSIONS

- Device distribution saved water.
- Expenditures on bath room kit program are cost-effective.
- Device kit distribution savings continued and customers went on to save more water.
- More than likely other factors play a role in water use reductions, but kits do play a role.

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Innovative Ways to Distribute Devices

– SmartDrips Distribution Effort:

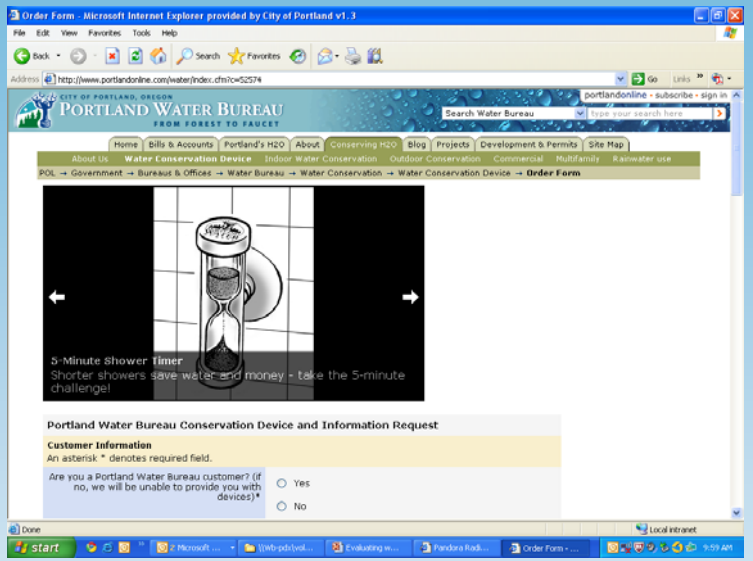
Partnership with Bureau of Transportation .

- 2006-2008 – 12,356 kits distributed by bike

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Innovative Ways to Distribute Devices

- Web-based orders
  - Build a web-based order form which can be access through the bureau internet.



  – Customer self-service, choose the items they want in their "customized kit"

  – Customer service staff also use the web order form, which improves efficiency for tracking info.

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Innovative Ways to Distribute Devices

- Partnerships with Community Service Agencies
  - For 2 years worked with local social service agencies to distribute kits to low income households
  - Leveraging exiting infrastructure, been able to distribute 1000 kits each year.

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Innovative Ways to Distribute Devices

- Customer Service Center
  - Have many people walk in each day to pay water bill.
  - Pilot project to distribute kits at our walk-in center.
  - 2008-2009 – 337 kits distributed.

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Contact:

Sarah Murphy Santner
Residential Water Conservation Coordinator
Portland Water Bureau
(503) 823-7444
sarah.santner@portlandoregon.gov

G. Hossein Parandvash
Economist
Portland Water Bureau
503.823.5350
hossein.parandvash@portlandoregon.gov

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET